

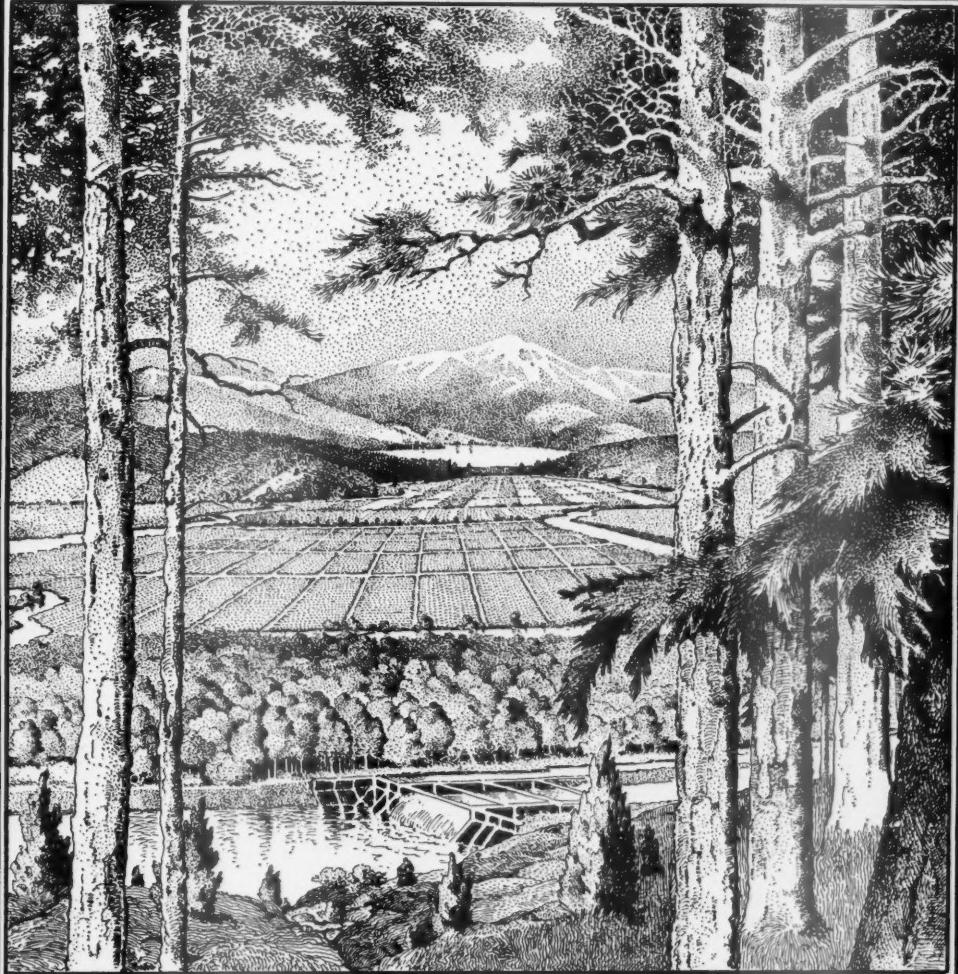
UNDERGROUND WATERS OF SOUTHERN CALIFORNIA, By W. C. MENDENHALL

Vol. X—No. 10

OCTOBER, 1904

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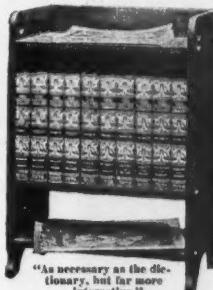
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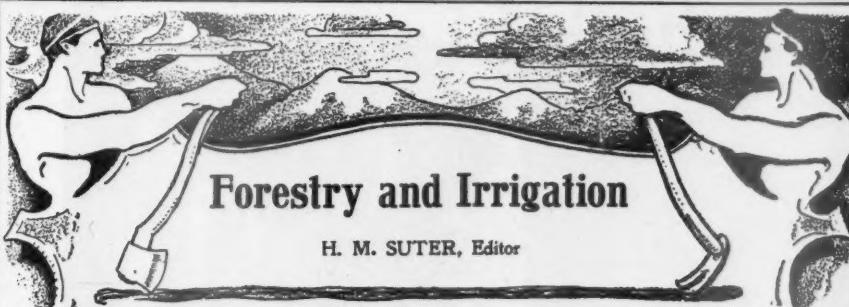
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CONTENTS FOR OCTOBER, 1904

FLOODS ON KANSAS RIVER *Frontispiece*

NEWS AND NOTES

American Forest Congress	437	Good Opening in Philippines	443
Louisiana Forest Law	438	Irrigation in Italy	443
Fire Control in California	438	Perpetual Injunction	444
Pennsylvania and the Fair	439	Largest Tree	444
Studying Underground Waters	439	Oregon Reclamation Work	444
Irrigation Congress	440	Progress in Arizona	445
Absaroka Forest Reserve	440	La Plata Project	445
Good Plank for Any Party	441	Favorable Outlook in California	446
Destruction of Western Forests	442		

JOHN ELLIS FIELD (*with portrait*) 447

UNDERGROUND WATERS OF SOUTHERN CALIFORNIA (*with map*)
Walter C. Mendenhall 448

THE BASKET WILLOW (*Illustrated*) 455

CONTROL OF KANSAS RIVER FLOODS (*Illustrated*) 460

FORESTRY AT THE UNIVERSITY OF MINNESOTA 463

EFFECT OF FORESTS ON WATER SUPPLY (*Illustrated*) T. P. Lukens 465

FOREST FIRES 469

FORESTRY AS APPLIED TO THE DEVELOPMENT OF KANSAS
Geo. W. Tincher 471

TRACK SUPPLIES AND TREATED TIMBERS 473

THE RANGE PROBLEM Professor R. H. Forbes 476

WOODS OF THE PHILIPPINES Eber C. Smith 479

PROPOSED IRRIGATION LAW 481

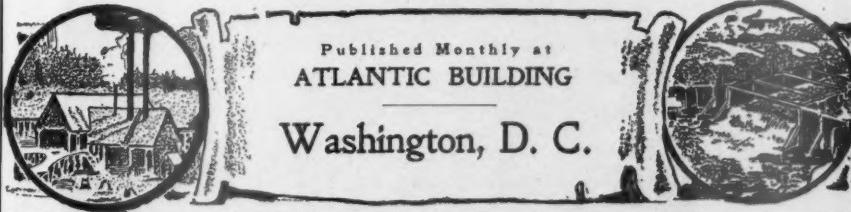
TO HARNESS THE MISSOURI Guy Elliot Mitchell 483

RECENT PUBLICATIONS 485

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MISSOURI PACIFIC RAILROAD BRIDGE AT THE LEFT.

Forestry and Irrigation.

VOL. X.

OCTOBER, 1904.

No. 10.

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AN

American Forest Congress

WILL BE HELD AT

Washington, D. C., January 2-6, 1905

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AMERICAN FORESTRY ASSOCIATION

This Congress is called to consider the forests in their relation to the great industries closely dependent upon them, such as lumbering, transportation, irrigation, mining, and grazing, and to forward the conservative use of the forest resources of the country, to meet the present and future needs of these great industries.

That this Congress is of national importance is shown by the fact that the President of the United States will address it, and has promised to receive its delegates; while the presence of many of the foremost men of our industrial life at its sessions assures definite and far-reaching results from its deliberations.

Altogether, this Congress promises to be the most notable event the forest movement in this country has known. Delegates will be present from the government bureaus having forest and irrigation work in charge; from the various lumbermen's associations; mining, stockmen's, and woodworking associations; engineering societies, and many other representative organizations.

The attendance promises to be the largest that has ever been present at a meeting devoted to forest subjects in this country. The official call for the Congress will be issued by the American Forestry Association in November; arrangements for special railroad rates are in progress, and information on this point, as well as on hotel and other matters, will be announced at an early date by the committee in charge.

NEWS AND NOTES.

Louisiana Forest Law.

The last session of the Louisiana legislature passed an act to establish a department of forestry to provide for the preservation of the forests, to prevent and suppress forest fires, and see to the reforesting of denuded lands.

It provides that the register of the state land office shall be commissioner of forestry, with an addition of \$500 in salary. With him four other citizens, serving without compensation, constitute the state forest commission, which shall see to the administration of the act. The act provides for fire wardens in the various counties of the state and a chief fire warden to personally superintend forest-fire control, at a salary of \$500 a year and his expenses. He is empowered to spend not to exceed \$5,000 per year for fire control, as he sees fit, for fire patrol and prevention in other ways. The parish fire wardens are to receive \$2 a day for time spent in this work—two-thirds from their parish and one-third from the state. The fire wardens are empowered to call upon all citizens to assist them in times of fire or danger of fire. Willful, negligent, or careless setting of forest fires that cause injury are punishable by a fine of not over \$500 or imprisonment for not over ten years, or both.

The law further provides that leaving camp-fires unquenched, using combustible wads in firearms, or carrying naked torches in forests shall be punished, whether injury result or not, by a fine of not more than \$100 or imprisonment for three months. The same penalties hold for defacing warning placards. Railroads are required to clear their right of way 50 feet on each side of their lines. Under this act Mr. A. W. Crandall becomes the commissioner of forestry.



Fire Control in California. The rains of last September throughout California practically closed at an early date the season of forest fire

danger in the state. They also brought to a successful culmination the first season's application of the plan of fire protection prepared by E. A. Sterling, of the Bureau of Forestry, for the California timber lands of the Diamond Match Company.

This plan, in addition to an annual systematized burning of the slash, provides for a system of trails and telephones whereby all fires may be reached and reported promptly, a lookout station at a sightly point, a regular patrol during the dry season, the posting of warning notices, the storing of fire-fighting tools at convenient points, and the working up of an anti-fire sentiment among the local inhabitants. There has also been a picked crew kept in readiness during the season to drop all other work and proceed immediately to the scene of the fire. The field work during the summer has been under the charge of B. J. Teasdale, who entered the company's service from the Bureau to act as fire warden.

All of the proposed trail and telephone lines were not completed this season, but the more important ones were finished, and the remainder will be put in next year. A regular patrol was maintained and a close watch kept of campers and others within the tract. The change in the sentiment of the local inhabitants during the year was very marked. From an attitude of indifference to fires they have come to look upon them as an evil, and not only exercise great personal care, but promptly report all fires seen or heard of. The season has ended without a serious fire on the match company's land, although extensive fires occurred on adjacent timber land.

In general, the fire season in California has been a serious one, as will be seen from our notes on September fires printed elsewhere in this number. As is usual, many fires were burning in the Sierra forests which were never reported. In Tehama county two large fires burned for over a month prior to the rains, but mostly in the chaparral

and open forest of an uninhabited region; hence no attention was paid to them. Near Sims, on the line of the Southern Pacific, and at various points in Shasta county, troublesome fires have existed. The two most serious fires, and the only ones given much newspaper space, occurred in the region adjacent to San Francisco Bay. One was in Marin county, near San Rafael, and for a time threatened the Mt. Tamalpais Railway and tavern; the other burned over a large area and destroyed much property in Santa Cruz county, and only by strenuous effort was kept from running through the state Redwood Park in the Big Basin.

Pennsylvania and the Fair. The following letter from Dr. J. T. Rothrock, until recently Commissioner of Forestry for Pennsylvania, explains why his state made no forest exhibit at the World's Fair:

Editor Forestry and Irrigation.

SIR: Mr. Alfred Gaskill's comments on page 404 of September issue of your journal are both natural and proper. He writes thus: "Far more significant is the failure of such leading states in the forestry movement as Pennsylvania, Maine, and Minnesota to show what they have done to maintain and extend their woodlands." It simply remains for Pennsylvania to say that at the time when application was made for space there were but 900 square feet available and we required at least 2,500 square feet in which to make suitable exhibition of what was doing here in forestry. We thought that no display at all was better than an inadequate one.

Individually, I have long believed that Pennsylvania could use the money available for forestry purposes to better advantage than by taking part in these constantly recurring expositions, to meet the demands of which attention and funds must be diverted from more productive work. However, out of respect to public opinion, Pennsylvania was prepared to have made a forestry exhibit if space could have been obtained.

In what has been said there is intended no suggestion of the unwilling-

ness on the part of the authorities to accord the room desired if it had been available.

J. T. ROTHROCK.

Studying Underground Waters.

Mr. Charles S. Slichter, engineer, U. S. Reclamation Service, who recently conducted the investigation of the underflow in the Arkansas River Valley in western Kansas, is now engaged in similar work in the vicinity of El Paso, Texas. A brief reconnaissance indicated that there could be no underflow of any consequence at the narrows of the Rio Grande above the city. At the site of the proposed international dam the distance between the walls of the gorge is less than 400 feet, and the Mexican borings seem to indicate that bed rock is reached at about 86 feet at deepest point. The limited cross-section of less than 40,000 square feet could not transmit a large volume of ground water, even if other conditions were favorable. The highest velocity ever determined for ground waters is 100 feet per 24 hours. Assuming this maximum velocity at the above cross-section and a porosity of one-third, the daily discharge would be 1,333,000 cubic feet, or 15 $\frac{1}{2}$ second feet. The gradient of the water plane at the narrows is but 4 feet to the mile, and all other indications point to a low rather than a high velocity.

There are none of the common and usual indications of an underflow at this point. If a free underflow existed, a perennial stream would undoubtedly exist in the narrow gorge above El Paso. In addition to a perennial surface flow through the narrowest portion of the gorge, above the gorge and near its converging sides the ground water should have a slightly artesian character; but none of these indications were found to be present.

Notwithstanding the above considerations, work was begun to determine the actual rate of underflow. In the coarsest strata of sand met with in drilling the wells the velocities were found to be between 2.7 and 2.9 feet per 24 hours.

An important fact brought out by the investigation is the increasing hardness

and saltiness of the water in the sand of the gorge with the depth penetrated. The increase can be noted from foot to foot. At a depth of 42 feet the water contains about 1,200 parts per 100,000 of common salt—not quite as strong as sea water.

Mr. Slichter examined the situation below El Paso with reference to the possibility of ground-water supply from wells. The mesa east and north of the city contains a very fine water-bearing sand at a depth of about 180 feet. The stratum is between 30 and 60 feet thick, and the material is too fine for good wells. At the southern boundary of this mesa the river runs at the present time about 40 feet higher than the top of the above-mentioned water-bearing sand. There is every indication that at the time the river cut the gorge above the city to the depth of 86 feet it cut into this deposit of sand and resorted and redeposited the material, carrying much of the finer material away. For this reason good wells can be had along the entire edge of the mesa wherever the river has done its work, except in a few instances where the river carried away all the sand and left a local deposit of clay and mud in its place. By running levels it was determined that the water plane slopes both from the mesa and from the river toward the region where water is being extensively pumped for irrigation. The water plane is about 2 to 3 feet below the surface of present running water in the river, indicating that both the river and the mesa contribute to the ground water taken from the wells. The river probably does not furnish much water to the sand on account of silt, except in times of flood, when the scour is deep.

This work, which is of the utmost interest and importance to citizens of the valley, will be carried forward as rapidly as possible, and will include an extension of the work to Las Cruces, New Mexico.



Irrigation Congress.

Judging from the widespread interest exhibited, the Twelfth National Irrigation Congress, to be held at

El Paso, Texas, November 15-18, promises to be the most successful yet convened. Mr. A. W. Gifford, who is secretary of the Southwestern Irrigation Association, and who has been actively working to secure full representation, has just returned to El Paso from a trip through California, undertaken with the object of stimulating interest in the Congress. He expresses great gratification at the general enthusiasm manifested, and states that hearty coöperation is promised by some of the most influential organizations and citizens of California. Mr. C. B. Boothe, executive chairman of the Congress, reports that Governor Pardue, of California, will head a strong delegation from that state.

President Diaz, who has evidenced a desire to attend the sessions of the Congress, has been sent, by messenger, a special invitation, signed by Senator Clark, as president of the Congress.

It is gratifying to observe the interest shown in the Congress, as evidenced by the hearty coöperation of those interested in irrigation throughout the West, and numerous exhibits will be made by fruit-growers and irrigators in general. California, Utah, Washington, Texas, and Nevada are to be represented by large delegations, and all previous records in attendance promise to be eclipsed.



Absaroka Forest Reserve. The Absaroka Forest Reserve of Montana was merged with the Teton and the Yellowstone forest reserves by proclamation of January 29, 1903, the whole taking the name of the Yellowstone Forest Reserve. The forest conditions in the Absaroka division of the reserve have been studied by Mr. John B. Leiberg, of the U. S. Geological Survey, which organization recently issued a bulletin on the subject.

As an introduction to the main subject, Mr. Leiberg gives a general description of the topography, drainage system, rock formations and soils, mining areas and minerals, agricultural lands, grazing lands, and lakes and tarns found in the Absaroka division of the reserve.

The forest in the reserve is almost

wholly coniferous. The trees are of greatly different ages. Stands 15 to 20 years old are associated with growths 75 to 100 years of age and with veteran stands 200 to 300 years old. This condition has been brought about by fire, the stands of different ages marking burns of different periods.

The timber in the reserve, which is valuable for commercial purposes, may be divided into two classes, that of sufficient dimensions and suitable qualities to furnish saw-logs, and that fit only for fuel, fencing, poles, railroad ties, and mine props. Owing to the preponderance of the lodgepole pine, with its slender, pole-like growth, and the generally low, stocky stature of the other species of trees, mill timber is scarce. Most of it is obtained, however, from the lodgepole pine, because that tree is accessible and abundant and uniformly distributed over the areas that have the most favorable climatic and soil conditions.

Next in volume comes the Engelmann spruce, which is little used either for mill timber, fuel, or fencing material, because the heaviest and best stands of the species occur in localities remote from transportation or demand. The red fir ranks next. Little of it is utilized, however, as it usually grows on rocky, steep slopes whence there is no means of transporting it to the outside world. The white pine and yellow pine form only an inconsiderable portion of the mill timber. The yield of mill timber varies from less than 1,000 feet, B. M., per acre in the higher areas and in the tracts adjacent to the foothills to 10,000 feet, B. M., on the tracts embraced in the Davis Creek and Middle West Boulder River bottoms, the Slough Creek bottoms, and portions of Buffalo Creek Valley. Notwithstanding rocky and comparatively barren soil, the region is capable of sustaining at least twice the amount of timber it now carries if fires were totally suppressed, grazing and cutting restricted, and sheeping absolutely prohibited.

Mr. Leiberg also includes a report on the Livingston and Big Timber quadrangles of Montana, which contain parts of the Absaroka division of the Yellow-

stone Forest Reserve. The examination was made primarily in order to classify the lands and estimate the timber within the boundaries of the reserve, but the land was classified and the timber estimated beyond the reserve boundaries in order to include all of the Livingston and Big Timber quadrangles.



Good Plank The following request for Any Party. for a plank in the Democratic state platform favoring needful forest legislation was submitted to the convention by a committee from the Colorado Forestry Association:

To the Democratic State Convention.

GENTLEMEN: We, the undersigned, a committee duly appointed by the Executive Board of the Colorado State Forestry Association for the express purpose herein named, respectfully present the enclosed resolution, asking that you insert it in your party platform:

For the reason that when we consider the importance of our forests in their bearing upon the leading industries of the state; when we see the vast destruction of timber on almost every mountain side; when we are told by those who best know that at least four to five-sixths of our virgin forests have been destroyed chiefly by careless fires, and when we further realize that the state has made no provision for forest management, that there is no executive officer to see that our forest laws are enforced, we are impressed that it is imperative that something be done, and done at once, to establish some well-defined and rational forest policy.

For this purpose, therefore, we appear in this manner, feeling assured that your honorable body will be interested and ready to coöperate in this movement, which we believe to be for the present and future welfare of our beloved commonwealth.

Respectfully submitted.

PLATT ROGERS,
E. B. MORGAN,
HELEN L. GRENFELL,
A. W. RUCKER,
JOHN S. TITCOMB,
Committee.



TWO VIEWS SHOWING COMPLETE DESTRUCTION OF WESTERN FORESTS BY REPEATED FOREST FIRES.

The plank requested is as follows:

Whereas the forests of the state are of the greatest importance for the production of timber and the conservation of moisture in the economy of our water supply; and

Whereas they are being destroyed by fire and wasteful methods of lumbering, to the serious detriment of our leading industries; therefore,

Be it resolved, That this convention earnestly recommends such legislation under the state constitution as shall provide for a Department of Forestry and the enactment of such laws as may be necessary to enable it to make our forests more permanent and useful.

This plank was adopted by the Republican State Convention as a part of its platform.

**Good
Opening in
Philippines.**

The United States. His address is care of the Philippine Exposition Board, World's Fair, St. Louis, where he will be glad to hear from foresters who would like to enter the Philippine service. At present there is an especially good opportunity for young men to secure positions in the Philippine Forestry Bureau. Particulars about the work and the salaries paid are included in an advertisement elsewhere in this issue.

**Irrigation
in Italy.**

In Italy it has been practiced for more than 500 years. It is, therefore, natural that Italian experience should be able to show much of value to American irrigators. For the purpose of determining what could be learned in that country which could be applied to our own problems, Dr. Elwood Mead, Chief of Irrigation and Drainage Investigations of the Office of Experiment Stations, U. S. Department of Agriculture, spent the summer of 1903 in the valley of the Po. A partial report of Dr. Mead's observations has just been issued by the Department of Agriculture as

Bulletin 144 of the Office of Experiment Stations. No attempt was made to make this an exhaustive monograph upon irrigation in northern Italy, but the study was made solely from the standpoint of obtaining suggestions for American irrigation practice.

Contrary to a very common opinion, the valley of the Po is not an arid region. The annual rainfall at Milan, the chief city of Lombardy, is more than 40 inches—greater than that of Cincinnati, Ohio, or Omaha, Neb., both of which are situated in regions where irrigation is seldom considered in connection with agriculture. The climate of Lombardy is not different from that of the Mississippi Valley, and the crops raised, with few exceptions, are the same. Notwithstanding this large rainfall and the fact that crops can be successfully raised without irrigation, the plains of Lombardy are a network of canals and drains. To secure the construction of one of these canals, the city of Milan gave a bonus of \$400,000. This canal cost \$6,000,000, or \$37.50 for each acre of land that can be served by it. It supplies water to 8,000 farmers, who pay from one to two dollars per acre per year for water. Some of this land supports as many as 800 people per square mile, and has increased in value since the building of the canal from 60 to 100 per cent, land which formerly sold for \$100 being worth from \$160 to \$200 per acre.

Under the Vettabbia Canal, which uses the sewage from Milan, meadows yield an annual crop worth \$300 per acre. Some of the fields have been used for meadows continuously for 700 years. Annual rentals for these lands are more than \$25 per acre. Sewage has been used on these fields for centuries without injury to the lands or to the healthfulness of the community. This great rise in land values and increase in productivity of lands, due to irrigation, in a region with a rainfall equal to that of the southern half of the Mississippi Valley and a climate no more favorable to crop production, leads to the conclusion that in irrigation this section has a means of at least doubling the present yield from its lands.

In Piedmont, which has an annual rainfall of more than 30 inches, or about the same as eastern Nebraska and Kansas, the Italian government has built nearly a thousand miles of canals and expended about \$20,000,000 for irrigation works. The annual income from the government canals in this province is nearly \$600,000. Pumping plants have been established to raise the water to lands above the government canals. One of these was put in at an expense of \$47 per acre for the lands irrigated, in addition to which the farmers are required to pay the annual maintenance expense and \$82 per year for a cubic foot of water per second. Irrigated land supplied by this pumping plant is worth three times as much as unirrigated land adjoining. Under another pumping plant the annual expense to the farmers is \$5.80 per acre, in addition to \$10 per year for a sinking fund, making an annual charge upon the farmers of nearly \$16 per acre; and this also in a region where crops can be raised successfully without irrigation.

The Italian government disposes of water directly to farmers at retail in some sections, and in others sells it to coöperative associations of farmers. One such association has 14,000 members, operates 9,600 miles of ditches, has 266 miles of telephone and telegraph lines, supplies water to 141,000 acres, and does an annual business of \$600,000. Eighty water masters are employed by the association to distribute the water to its members. The farmers in this association pay from \$1.60 to \$9 per acre per year for water, according to the distances of their land from the main canal and the crops raised.

In addition to giving information as to the organization of the industry in Italy, the bulletin describes the principal canals of Lombardy and Piedmont, and gives details as to the structures for diverting water and carrying it over or under the streams or canals crossed. Drawings and photographs of a large number of structures are given.

Italian engineers have given more attention to the measurement of water than any other body of men in the world. The bulletin describes the methods of

measurement of water in use along the Po, and gives a general discussion of the subject of water measurement.

The most striking points brought out by the report are the large expenditures for irrigation in a region where crops can be raised without it, the enduring and expensive nature of the structures, and the efficient coöperation of irrigators in using water and in canal management. Along each of these lines Italian experience is full of suggestion for those interested in American irrigation.

Perpetual Injunction.

In the United States circuit court at Los Angeles recently Judge Wellborn signed decrees in the celebrated Fresno "sheep cases," granting a perpetual injunction against the defendants, which restrains them from driving their sheep across the Sierra Forest Reservation without permission from the Government officers.

Marvin Simpson, George Shipp, Frank Estelle, Anderson Blasingame, and John Shipp, all of Fresno, are the defendants in these cases, and, as they are among the largest sheep-raisers in the state, the cases have attracted a great deal of attention.

Largest Tree. The largest tree in the world is reported again, this time from the vicinity of Mt. Etna. It is a chestnut, said to be 212 feet in circumference 60 feet from the ground. More remarkable than its huge girth is the point on the trunk at which this measurement is said to have been made.

Oregon Reclamation Work.

Under the direction of Mr. J. T. Whistler, engineer in charge of the Malheur (Oregon) reclamation project, field parties were engaged during August in the development of topography of irrigable lands under the system, followed by location of preliminary canal lines. Drill work was begun the first of the month on four possible dam sites at the upper end

of the canyon below Little Valley. Two or more holes were put down at each of these sites, showing apparently good foundation for dam at from five to fifteen feet below the surface. At the direction of the Board of Consulting Engineers, a more complete investigation will be made of the most favorable of these four sites.

Discharge measurements and other data relating to the use of water under present ditches in the Malheur project are being continued.

During the month successive mass meetings were held by the citizens in order to organize an association to legally take up the proposal of the Reclamation Service. A mass meeting on the 9th ratified the proposed articles of incorporation for a water users' association along the lines of the Salt River Valley Water Users' Association, and a committee of seventeen representative men of the valley was authorized to solicit subscriptions under these articles. The state law requires a majority of capital stock of the corporation to be subscribed before the election of officers can take place, and also thirty days' notice of said election. A majority of the stock having been subscribed prior to the 29th of August, the election was advertised to take place on the 27th of September.

Field parties have been busy carrying on investigations in other parts of the state, looking to the storage and diversion of waters for the irrigation of lands in various localities. These investigations, however, have not been carried to a point where it is possible to determine the feasibility of the several schemes under contemplation.

Progress in Arizona.

Mr. Louis C. Hill, supervising engineer in charge of the Salt River project, Arizona, reports considerable damage by high water during August on the headworks and sluicing tunnels. The water in the river rose to a point higher than has been reached since 1891, and filled the headworks tunnel about half full of mud. It stood some three feet over the top of the sluicing tunnel and made the canyon road im-

passable. A rough estimate showed 20,000 second-feet passing the dam site.

Six tunnels are now driven, and it is expected that four others will be finished during the month of September. Operations on the Phoenix-Roosevelt road have progressed satisfactorily, and most of the heaviest work of the road is completed.

The investigations on the two reservoir sites on the upper Gila are nearly completed, and a gaging station is to be established here and measurements made of the quantity of water in the river, as the whole question as to the value of this reservoir hinges upon the water supply.

August saw the practical completion of the chemical investigations on the Salt River and the wells around Phoenix and the country west and southwest of that city. A large number of analyses were made and maps and reports prepared which give very complete information as to the distribution of salt in the underground waters of Salt River Valley.



La Plata Project.

Upon the recommendation of the Director of the U.S. Geological Survey

15 townships of land lying in and tributary to the La Plata and Animas river valleys in New Mexico, and aggregating approximately 308,736 acres and 4½ townships, embracing approximately 80,640 acres lying in Colorado along the Animas River, have been segregated under the first form of withdrawal, pending investigations by the engineers of the Reclamation Service in connection with their reclamation by irrigation.

This project, known as the La Plata project, is located on a tributary of the La Plata River in San Juan county, in northwestern New Mexico. The main source of water supply is from Animas River and its tributaries, and possibly from Los Pinos River in Colorado. The supply will be diverted from Animas River either near the Colorado-New Mexico line and conveyed to lands lying in and along the La Plata Valley by means of canals aggregating approxi-

mately 100 miles in length, or by means of comparatively short tunnels through the high divide between the Animas and La Plata rivers and a much shorter line of canals connecting the ends of the tunnels with the points of diversion and delivery.

If the development of this project, which contemplates the reclamation of approximately 50,000 acres of land, is found feasible, it will be necessary to supplement the minimum flow in Animas River during a portion of the irrigating season by storage, both at the head of La Plata Valley and on Animas River, there being an abundance of water for this purpose during high-water period.

Preliminary investigations have been made and reconnaissance surveys for the purpose of locating storage facilities. At the present time field parties are being equipped for a survey of the diversion canal lines and possible reservoir sites and lands affected by the project. Probably two or three months will be required for this work.



Favorable Outlook in California.

The progress made by the engineers of the Reclamation Service in California during August is most gratifying. Stream measurements, duty of water measurements, and evaporation records were maintained in various places in the state, and the several projects have received general and individual attention.

Yuma Project.—Work on this project consisted principally in making plans and estimates on canal lines, quantities for canals, and estimates on a pumping plant for the Yuma mesa, and in the preparation of a map of farm units for this project along the lines of practice established elsewhere. As early as August 27, 75 per cent of the area of private lands below the canals and inside the levees had signed the contracts necessary prior to advertising for bids for construction. When all the lands subject to the Reclamation Act—for instance, the Indian reservation—are included, this percentage is materially higher; in fact, nearly sufficient.

Klamath Project.—Surveys are being made of the Horse Fly and Clear Lake reservoir sites, and a topographic survey of the Klamath River near Keno, where it is possible to lower the channel and drain the lower Klamath region. A determination of the area of irrigable lands and surveys and other preliminary work will be rapidly pushed in order to determine the feasibility of this project at as early a date as possible.

Owens Valley Project.—During the month of August, Mr. J. C. Clausen, of the Reclamation Service, who has charge of the Owens Valley project, completed the examination of all the sm a mountain lakes along the eastern side of the Sierra Nevadas tributary to Owens Valley. The most promising of these have been surveyed sufficiently to compute the capacities of reservoir sites. A map of the irrigated lands in the valley is being revised for the purpose of making a distinction between the lands with sufficient water supply and those with insufficient supply, and a study is being made in the valley in a preliminary way of a large percentage of land that through irrigation has become swamp or alkali.

Another inspection was made of the Long Valley dam site. The rock at this site is of volcanic origin, weighing about 100 pounds to the cubic foot, and appears to be in one well-consolidated mass and not in independent layers. As the use of this reservoir site is entirely dependent upon bed-rock conditions, a thorough exploration with the diamond-drill machine will be made. If this reservoir is found feasible, a detailed survey will be made in the valley.

It is believed that this project would supply water to from 75,000 to 100,000 acres, 40,000 acres of that amount now being irrigated in the valley. The engineers believe that the smaller tributaries of Owens River will supply sufficient water during spring and early summer for all the systems, and by holding back the entire flood flow of the Owens River for late summer use it will be possible to greatly extend and benefit the irrigation system in the valley and supply water for the irrigation of additional lands.



JOHN ELLIS FIELD,
IN CHARGE OF IMPORTANT RECLAMATION PROJECTS IN THE WEST.

AN engineer in whom technical skill and administrative ability are combined to a high degree is Mr. John E. Field, of the U. S. Reclamation Service. He was born in Colorado on May 13, 1867, and graduated from Yale with the degree of Ph. B. in 1888. From 1888 to 1893 he was engaged in the practice of mining, civil and hydraulic engineering in the mining camps of Colorado. From 1888 to 1889 he was assayer and chemist for the Aspen Public Ore Sampling Works in Denver, and served in a similar capacity from 1890 to 1891 for the Taylor and Brenton Sampling Works. He then engaged in civil and hydraulic engineering practice until 1893, when he was appointed chief examiner of mineral surveys for the United States surveyor-general of Colorado, serving in that capacity until 1899, when he became assistant engineer on the board of public works at Denver. In 1901 Mr. Field was made deputy state hydraulic engineer of Colorado, and in 1903 was appointed an engineer in the Reclamation Service. He is the author of various bulletins published by the United States Department of Agriculture, and at present is directing the work in connection with several important reclamation projects in Wyoming.

THE UNDERGROUND WATERS OF SOUTHERN CALIFORNIA.*

BY

WALTER C. MENDENHALL,

U. S. GEOLOGICAL SURVEY.

IT often happens that in inaugurating work along new lines only a few far-sighted men are able to discern the future bearing of that work, so that those engaged in it are constantly met with skepticism as to its usefulness. This is particularly true in America, where the direct practical question—What is it for?—must be met and a satisfactory answer returned before support will be given to any line of activity. This is no less true of governmental than of private work. It is indeed much more emphatically true of work of a public nature, because as each citizen contributes to the support of that work he feels a personal interest in it, and, true to the instinct of his race, demands that it have a direct and useful bearing upon every-day affairs. This is on the whole a most healthful spirit. Its effect is to subject each public project to a searching examination, in which those who plan it must be able to justify it on the broad basis of usefulness.

Our government bureaus, which have been created and have expanded in an atmosphere of this kind, are eminently practical. Their constant endeavor is to secure results of direct benefit to the body politic and of immediate application in daily life. To the more abstruse results, whose bearing upon practical problems is less manifest or more slowly realized, much less attention is devoted. As a consequence there is little of the aloofness in the public service here, which marks it in some of the older countries of the continent.

The Geological Survey is one of a number of such government bureaus which endeavors always to guide its work into useful channels and to give it a direct practical bearing. When it

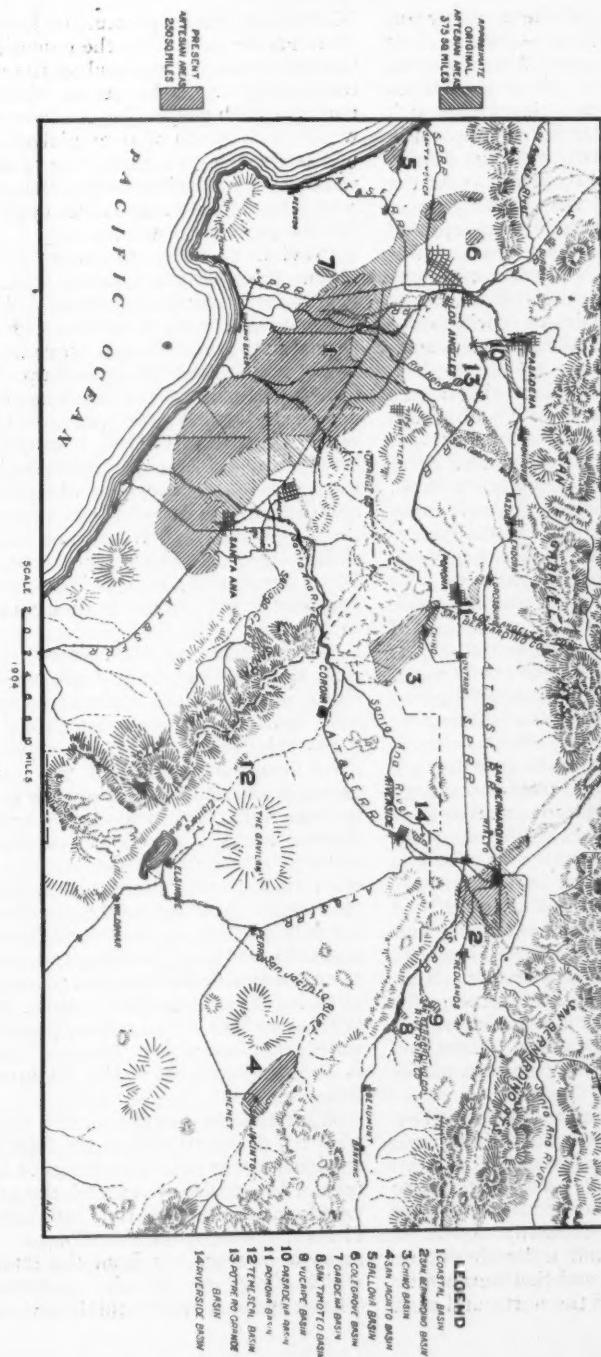
came into existence, 25 years ago, the value of such work as it was created to do had been made manifest through the geographic and geologic achievements of its predecessors, the various transcontinental surveys. Its maps, upon which the physical features of the various sections are faithfully shown, and its reports upon the mineral deposits of the West, and later of the East—reports in which the deductions of its special students were made available for the use of the practical mining man—filled a distinct want and led to the support of the Bureau by Congress and to the gradual extension of its functions.

As the most attractive parts of the West were settled and interest was aroused in the possibility of reclaiming its arid lands, the Survey, responding to this interest, undertook a series of observations to determine the amount of water available for the purpose. That branch of the organization which undertook this work is known as the Division of Hydrography. When, two years ago, the plans for rescuing the arid lands from their desert condition crystallized in the famous Reclamation Act, the Secretary of the Interior, to whom was entrusted the task of carrying its provisions into effect, turned to the Bureau, which for a decade had been collecting the data, without which no single project could safely be undertaken, and the Director of the Geological Survey was instructed to take up the actual work of constructing great irrigating systems, to be sold at cost to the communities benefited.

Out of the experience of the Hydrographic Branch and the Reclamation Service there arose the need for a special study of underground waters—their oc-

* Published by permission of the Director, U. S. Geological Survey.

**MAP
of the
ARTESIAN BASINS
in the
VALLEY OF SOUTHERN CALIFORNIA DIV. OF HYDROLOGY**



currence, volume, and the laws governing their replenishment—since in parts of the arid and semi-arid West these are important sources of supply for domestic purposes and for irrigation. Such studies had been carried out especially along the eastern slope of the Rocky Mountains and the adjacent parts of the Great Plains by the Hydrographic Branch previous to the organization of the Reclamation Service; but soon after its organization this work was segregated into a separate division, known as the Division of Hydrology, with eastern and western sections, under separate chiefs.

For the actual field work in this division, geologists have usually been detailed from the Division of Geology, with which, and the Reclamation Service, the new division is closely affiliated. Its problems are largely geologic problems, since the distribution, the circulation, and the quantities of underground waters depend upon geologic facts. Its relations with the hydrographic work are most intimate, as the questions of replenishment of underground reservoirs and drafts upon them are in many cases questions whose answers depend upon water and rainfall measurements.

One of the first important fields in which work was undertaken by the new division is that of the valley of southern California, long well known throughout the United States as the center of orange culture, and as possessed of a mild and equable climate which is rapidly making it to America what the south of France is to Europe, a region of beautiful homes and a center of wealth, culture, and pleasant leisure. This work is now well under way, its results are rapidly being made available, and they promise to be of great interest and value to the people of this part of the Southwest.

The greatest population and the highest cultural interests of southern California are distributed through a wide, beautifully diversified valley that extends 80 miles inland from the Pacific at Port Los Angeles, and is effectually separated from the Mohave and Colorado deserts by the San Gabriel and San Bernardino mountain ranges on the north and east.

These high groups protect the lands on their Pacific slope from the climatic extremes of the deserts, and at the same time wring from the ocean winds the moisture with which they are laden and which in the form of perennial streams makes possible the high state of cultivation which has given some of the adjacent agricultural lands values of \$2,000 or even \$3,000 per acre.

Previous to man's occupancy of this region the streams, issuing from the mountain canyons as perennial flows, sank at once, except in cases of rare floods, into the alluvial gravels and sands, which have been piled up about the canyon mouths as evidences of the deliberate, but unceasing, erosional processes of the past ages. Percolating slowly seaward through this alluvium, the waters encountering subterranean obstructions are forced to the surface at certain points in their courses, only to sink again once the obstruction is passed. Thus, some of the rivers disappear and reappear several times in their passage to the sea.

When white men first entered the region they settled about these areas of rising waters, points where the streams were forced out as springs by some impenetrable body of rock or clay. In these damp lands irrigation was unnecessary, and if it became desirable to extend the cultivated area slightly beyond them a short ditch sufficed to carry the water to the desired spot, so that the few irrigation projects were of the simplest sort. Average rainfall in the valley is from 10 to 20 inches, the greater amount near the mountains, the lesser at some distance from them, and practically all of it falls in the winter months, from October to May. Irrigation, therefore, except on these moist "ciénegas" lands, is necessary to mature the majority of crops.

With the slow settlement of the region by Americans after the Mexican cession and the gold discoveries in California, the desire to extend the cultivated areas led to the building of ditches, either from the ciénegas, the areas of springs, or from the streams which flow out of the mountains. These systems were rapidly extended

and improved, until practically all of the flowing mountain and valley waters were appropriated and made useful for irrigation or as a source of domestic supply for the growing villages and cities.

The next step taken to increase the water resources was usually in the direction of attempts to intercept the subsurface seepage by systems of shafts and tunnels, or to increase the flow of the large *cienegas* by similar means.

In two or three instances storage reservoirs have been built, whose object is to save those excess waters which pass to the sea during the exceptional floods of winter, and thus are entirely lost. Notable among reservoirs of this type is the Bear Valley dam, in the San Bernardino Mountains, at an elevation of 6,500 feet. Its waters furnish the main supply for the flourishing colony tributary to Redlands, in the eastern end of the valley. Similarly the Hemet dam, in the San Jacinto Mountains, stores the winter rains for use during the irrigating season on the plains in the vicinity of Hemet. Other unique features in hydraulic engineering are the submerged dams in the Pacoima Wash, San Fernando Valley, and in the canyon of Santiago Creek, Orange county. These are concrete structures, built across the underground channels of the streams to intercept the percolating waters as they find their way seaward through the porous sands and gravels of the stream bed. The waters thus intercepted are forced to the surface by the dam or are pumped from its upper side and distributed in the usual manner by main pipes and laterals to the lands which it is desired to irrigate.

In no part of the United States have the methods of irrigation engineering been so highly developed as here. A few of the less important old canals are cut in earth and are unlined, with irregular grades and leaky beds; but all the more important systems have been built by engineers after careful surveys, are cement lined or of concrete construction, many of them covered and supplied with most effective headworks and distributing systems. Recent practice has been in the direction of using con-

crete pipe for the main lines, thus preventing all loss of water from leakage or evaporation in transit from its source to the point of distribution.

In late years, because of the complete appropriation of all the surface streams and a natural desire to extend the areas so profitably cultivated, water-users have turned their attention more, and more to the subterranean supplies and in some cases flourishing communities have been built up which depend entirely upon these for their irrigation water.

As a result of the geologic and climatic processes which have given the picturesque combinations of mountain and plain that make up the landscape and much of the charm of southern California, a number of deep and capacious underground reservoirs have formed, which through the past centuries have been charged with the waters flowing from the mountains, and are now yielding these waters that the tributary lands may be made fruitful.

The origin of these basins in its broad outlines is simple, although the details may often be most complex. In general the high mountains are areas which have been uplifted during the crustal movements that have been so marked a feature of the later geologic history of the region, and the valleys are areas which have been depressed during the same processes. These furnish unusual types of valleys, whose width and extent bear no particular relation to the streams that flow through them. The normal stream valley, unlike these California valleys, has been cut by the stream which occupies it, is broad and flat where the stream is large, constricted where the stream is small, and is in every way adjusted to the stream that has produced it. But these basins, which together constitute the region known as the Valley of Southern California, owe their origin to earth movements instead of stream action, and the principal function of the streams has been not to deepen and broaden them, but to fill them up, smoothing them and partially burying the inequalities which resulted from the crinkling and buckling of the earth's crust, to which they are due.

Thus, as the San Bernardino Mountains were uplifted and the valley to the south of them sank, the streams rising in the high range carried quantities of detritus, boulders, gravel, sand, and clay into the lowland, and there deposited it. The rock floor of this valley is below sea-level, while its present surface is 1,000 to 1,500 feet above. This surface has been thus raised by the accumulation of material brought in by the mountain streams—loose, porous detritus, saturated by the mountain waters, and so constituting a great underground reservoir.

Similarly, while the ridge, which in various parts is known as the San José Hills, the Puente Hills, and the Santa Ana Mountains, has been uplifted, an area north of it has been depressed until its bedrock bottom, in places at least, lies below sea-level. This valley has also been filled by the loose material brought in by the San Antonio, the Santa Ana, and other streams, until the valley level is now several hundred feet above the sea. This great mass of loose débris, like that in the San Bernardino Valley, has been saturated by water supplied by the rainfall of the past, and serves as a storage reservoir.

Between the Santa Ana Mountains and their extension on the one side and the Pacific Ocean on the other lies the coastal plain of southern California, 10 or 20 miles wide and with a northwest-southeast dimension of 40 or 50 miles. This again is a lowland, built up largely of sands and gravels contributed by the various rivers which flow across it. The waves and currents of the ocean have probably contributed to the supply and have certainly aided in its distribution. These alluvial and marine deposits are saturated, as are the exclusively alluvial deposits farther inland, and constitute a very large underground reservoir of fresh water.

In portions of all of these basins, whose origin has been thus roughly sketched, the alteration of coarse and fine deposits, pervious and impervious beds, representing more or less rapid deposition, has been such that some of the waters, percolating along the easiest channel, have passed beneath sloping,

overlying beds of clay, and, accumulating there under pressure, flow when the impervious bed above them is pierced. Practically all of the artesian waters in the valley—and they are of great importance and wide distribution—occur under these conditions. The synclinal rock basins, which have come to be recognized as typical of regions in which artesian waters are found, are of little importance here.

These special artesian conditions, which are characteristic of the alluvial fans and the Coastal Plain deposits, possess certain definite attributes, some of which are advantageous and others of which are disadvantageous, from the point of view of the water-user.

In the first place, the gravels are loose, free, and coarse, so that they have a high transmission capacity, the water passing through them readily. Under these conditions there is no possibility of failure from the cause effective in the Denver basin, for example, namely, an inability on the part of the water-bearing rock to transmit the waters as fast as they are withdrawn by the wells. But this very openness creates another danger, that of exhaustion of the stored waters, which flow so freely to the point of exit that shallow wells of 10-inch bore have yielded as much as 400 miner's inches.

Again, in the majority of the basins the first water-bearing stratum is found at a very moderate depth, often less than 100 feet. Small wells may be sunk to such depths at very slight cost—so slight, indeed, that ranchers have found it more economical to sink a number on a small tract than to distribute the water from a central well. This condition has encouraged larger drafts upon the supply than would be made in an artesian basin, where the waters were farther from the surface and less readily accessible.

In its preliminary work upon the underground waters of southern California, the U. S. Geological Survey has mapped the principal artesian areas in their present and their original outlines. The results which are shown in the accompanying illustration are of considerable interest, and reveal the rather astonishing fact that at one time this semi-arid

region contained 375 square miles of artesian water-bearing lands, distributed through a number of basins—that is, artesian conditions existed under approximately one-sixth of the valley lands which could be made tillable and productive by the application of water. In addition, there were large areas bordering the artesian belts in which the ground water lay near enough to the surface to be accessible by pumps of various sorts, and in some districts these have been extensively utilized for irrigation.

The principal of the artesian basins are those of the Coastal Plain, Chino, San Bernardino, and San Jacinto, with approximate original areas of 295, 24, 30, and 14 square miles respectively. The water supplied by each of these has been extensively drawn upon during the past decade, the heaviest drafts being from the Coastal Plain and the San Bernardino sources. In the former case the waters supply the towns of the coast, and are used for the diversified crops of citrus and deciduous fruits, alfalfa, walnuts, grapes, and celery, which are raised there. The underground San Bernardino waters supply the towns of San Bernardino, Colton, and Riverside, are used for local irrigation within the San Bernardino valley, and are the principal source from which the splendid Riverside colony draws its supply for irrigation.

These subterranean sources have been most extensively developed within the past ten years. Practically all the acreage added to the irrigated districts within that time have been through the addition of artesian or pumped waters to the surface supply. These same years have on the whole been years of low rainfall in southern California, just as the previous decade, during which these developments began, was one of high rainfall. Under the combination of heavy withdrawals of ground waters and a shortage of the rain, which is depended upon to recharge the subterranean reservoirs, these have declined notably. As a result, the original area of 375 square miles of artesian lands has shrunken 33 per cent, to 250 square miles. Pressures and yield in wells

which are still flowing have notably decreased, the ground-water level outside the artesian belts has declined, and a feeling of uneasiness pervades some of the irrigating communities as to the permanence of their supply. On the whole, the subterranean reservoirs must be regarded as resisting the drafts upon them remarkably well. The summer waters which once flowed from the mountain canyons out upon the valley washes, where they promptly sank and added their volume to that of the stored underground supplies, have been appropriated and are used for irrigation. The proportion of them that escapes direct evaporation from the soil and indirect evaporation by transpiration through the plants varies with soils and irrigation practice, but must on the whole be small. This small residue alone is now added to the underground reserves, where formerly nearly all of the summer flow contributed. The storm waters of the winter season have always been the chief factor in filling the subsurface gravels, and these are still available in greater part, although a few storage reservoirs, like that of Hemet and Bear Valley, intercept flood waters, a part of which, were they not thus intercepted, would be absorbed on their way to the sea by the gravels. These are factors which have diminished the annual accessions to the underground supplies, although, if the communities as a whole are considered, storage of flood waters must be considered most economical engineering, since it undoubtedly diminishes the total loss through excessive floods. It is only from the special point of view of the companies or communities immediately dependent upon the saturated bodies of gravel for a supply that this storage can be considered disadvantageous. On the other hand, with the partial drainage of the gravels their absorptive capacity is increased, and in consequence a larger proportion of the flood waters must be taken up as they flow across the valleys than before. Actually, therefore, by drawing heavily upon the underground reservoirs, the amount of water which is lost in floods is decreased, and the total

amount available for irrigation is increased by an unknown but certainly not great amount. The algebraic sum of all these factors, of which the principal are the rainfall and the direct drafts upon supply, has without question been a loss for the ten years past in most parts of southern California.

In a few cases the lowering of the plane of saturation has been serious, a drop of 60 or 70 feet being recorded extremes for the period from 1900 to 1904, during which the deficiency of rainfall has been roughly 20 per cent. In other sections, where the body of saturated gravels drawn upon has been larger, or where the drafts have not been so great, the diminution of supply has been less marked, but the phenomena of a lowering ground-water level, shrinking artesian areas, and a diminishing artesian flow are general. This fact is not in itself enough to justify alarm. It is recognized that the proper function of these stored supplies is to tide the communities through the dry periods. They will be most heavily drawn upon when the rainfall is lightest, and will then inevitably shrink, just as a nation's gold reserve will shrink in the stress of war.

As a compensating influence, they should be subject to comparatively light drafts when the rainfall is heavy, as less water is required for irrigation then, and the surface streams, flowing near their maximum, are supplying the greater part of this minimum required amount. It is during such periods that the ground-water level should be restored, and the artesian areas expand to their original outlines. As the past decade has, on the whole, been one during which the precipitation is well below the general average, a decline is not a matter of surprise. The danger to irrigating communities which depend upon subterranean waters whose amount can not be directly measured, and is therefore peculiarly liable to overestimation by our optimistic American communities, is that they will not restrict themselves in their use of these reserve supplies during dry years to an amount which will be restored during wet seasons. It is easy to sink more wells,

pump more water, and reclaim more land. It is difficult and requires patience and self-restraint to check development until it is determined how far this process can be carried without permanent depletion of the reserves and resultant injury to the communities. In some districts in the valley of southern California the responsible far-sighted citizens are endeavoring to create a conservative sentiment, opposed to the further reclamation of virgin lands until the effect of a series of years of abundant rainfall upon the falling water plane can be determined. Evidence already exists to show that in particular localities, at least, average rainfall will check the rate of the decline, but will not stop it. In the face of this fact, economy in the use of water and conservatism in its development are imperative.

The abundance of water in the moist lands has generated in their owners habits of wastefulness and prodigality which are out of place in communities in semi-arid regions, whose future depends entirely upon the stability of the water supply. California is prodigal in many things. Habits of economy do not come easily to her. She has always received and dispensed with equal lavishness, and a part of her great charm is due to this abounding generosity. Her citizens must learn, however, that any natural resource less inexhaustible than sunshine and pure air may be depleted if spent too freely; that much more may be accomplished with it if its value is appreciated and due care is exercised in its use. She must come to understand unequivocally that the citizen who uses unnecessarily or otherwise wastes her water supplies, which are as essential as her balmy air and bright days to the extension of that hospitality in which she takes such pride, is a public enemy who will sacrifice the interests of his neighbors, his community, and his state to his own thoughtlessness, his own avarice, or his own indolence.

Care is just as essential where the life-giving fluid seems most abundant as in those other localities where its scarcity makes an admonition to economy trite. Indeed, the greatest shrinkages in artesian basins are due particularly to the

drilling and the careless handling of too many wells in the lowest, best watered parts of the artesian area, where the depletion is felt last and least seriously.

Drafts here tap the basin at its lowest and most vulnerable point, and draw the water away from the higher, less favorably situated lands.

THE BASKET WILLOW.

THE BUREAU OF FORESTRY SUGGESTS A NEW METHOD OF GROWING WILLOWS THAT WILL YIELD A BETTER GRADE AND INCREASE PRODUCTION PER ACRE.

THE culture and manufacture of basket willow have not attained in the United States the degree of perfection and profit that mark the industry in Europe. This is for several reasons, the most important being, the relative compensation of labor and the failure of the American grower to adopt the most improved methods. The growing, harvesting, care, and manufacture of willow require manual labor wholly unassisted by machinery. The cheap labor of Europe has grown willow, and woven it into baskets at a profit impossible with us and our better paid labor. American ingenuity has still further complicated the issue by producing a cheap split-wood basket to take the place of the more expensive and durable

willow. Thus an industry of good possibilities is languishing.

The Bureau of Forestry has taken up the matter and given it careful study. Its expert has thoroughly investigated the methods of culture and manufacture both in this country and in England, Germany, and Holland. In addition the Bureau has established a willow plantation on the Department's experimental grounds near Washington, D. C., where the best species of basket willows were set out on different soils and spaced in accordance with different methods of planting. The results of this research will shortly be made known by the Bureau in a bulletin entitled "The Basket Willow."

The Bureau's purpose was to discover



PURPLE OR WELSH WILLOW (*Salix purpurea*) PLANTED 3 FEET BY 1 FOOT. MARYLAND.
SEPTEMBER, 1902.



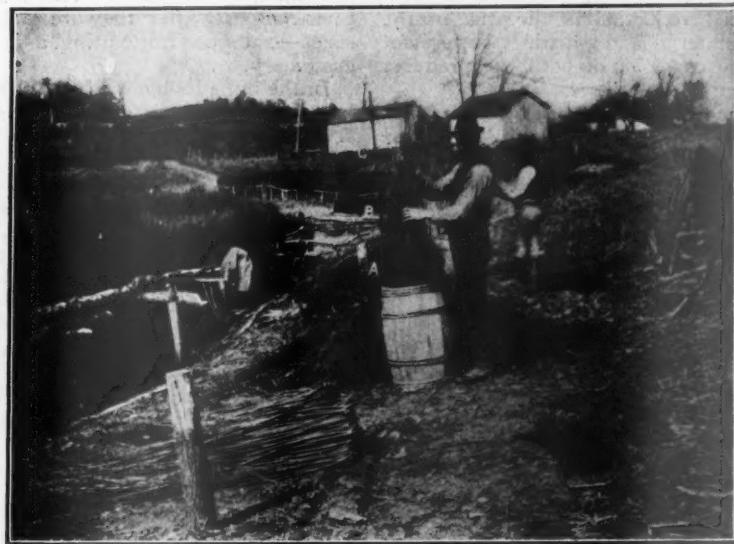
TYPICAL WILLOW BOTTOM LAND. MARYLAND.



WILLOWS IN THE PIT, SPROUTED AND READY FOR PEELING.



PEELING WILLOWS IN THE SAP.



DRAFTING (SORTING) WILLOWS.

a means of reducing the cost of the raw product, peeled and unpeeled willow rods, and also of improving the quality. This has been definitely ascertained. It is entirely a matter of properly regulating the distance between the sets in planting, care in cutting the crop of rods, and in selecting better species and strains of willow. The custom has been to plant in rows 3 feet apart, spacing a foot in the rows between the sets. A far better plan is to put the rows only 20 inches apart and reduce the distance between the sets to 9 inches. When this is done and the crop is cut close to the ground the rods will be longer and less branched, the plants longer lived, and the yield per acre much greater. The initial cost is slightly higher than under existing methods, but this is more than offset by the increased returns. At present an average production of six tons of green rods per acre is exceptional; by the method now advocated by the Bureau eight or more tons per acre of better rods can be produced. When to improved methods of culture, the advantages from a choice of better European varieties of willows for planting are added, the result will be a marked reduction in the price of the raw material and a distinct betterment of the condition of both the producer and manufacturer.

The growing of basket willows was introduced into the United States some sixty years ago by German basket-makers, who settled in western New York and Pennsylvania. They first attempted to use wild willows, but soon abandoned these as impracticable and imported the purple or Welsh willow. They grew the rods, and the manufacture into baskets was made profitable by whole families engaging in the weaving. Their product has always been a cheap variety of basket, since they use steam in peeling the rods, which gives them an undesirable dark color. When the industry was extended farther west and down to the Baltimore district, Maryland, hand-peeled rods were used and a much higher grade basket manufactured. But this country, in the extensive use of willow-ware, has never approached Europe, where are found

not only heavy farm baskets and receptacles made of unpeeled willow, but market, clothes, and fruit baskets of peeled willow, furniture, hampers, and trunks, and most artistically wrought split willow-ware designed for countless other uses. Could all these be as cheaply manufactured here as there, their use by us would doubtless be as extensive as that across the sea, for willow-ware is not only prettier than its substitutes, but, what is still more important, lighter and more durable.

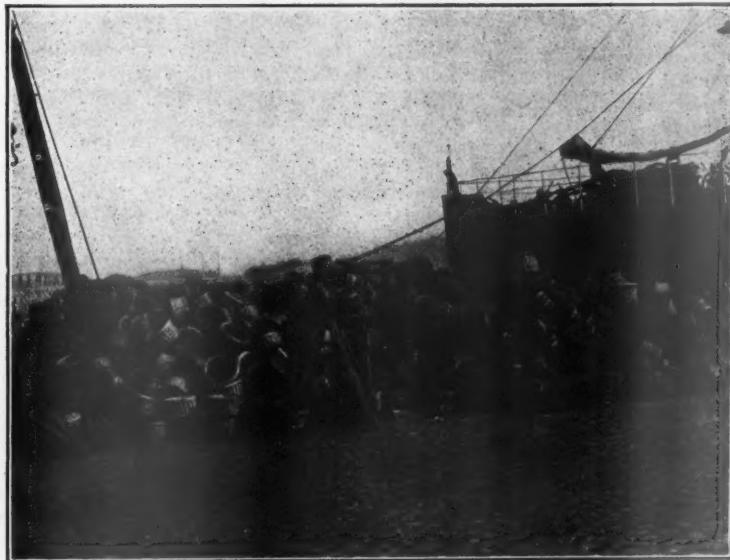
Another use for willow in this country is found in the growing demand for willow furniture, which has become fashionable in the North, while in the warm climate of the South it is rapidly taking the place of upholstered furniture. Good wages can be paid in the manufacture of this kind of furniture. It is a profitable industry and steadily growing in importance, while willow-basket making has barely held its own in the last decade. The demand for furniture material has been met to this time chiefly by importing French rods. But this can be changed if our own willow-growers will adopt more scientific methods of culture and market their rods only after they are well seasoned—not soon after cutting, as is now customary.

In the bulletin by William F. Hubbard, which the Bureau will issue in a few days, every aspect of willow culture and manufacture is exhaustively treated. The character of the ground to be used, preliminary cultivation, planting, weeding and cultivation, cutting, sorting, peeling, and packing, all are discussed thoroughly, and advice as to each branch of the work is clearly given. The virtues and defects of the different species of willows suited to basket manufacture are described. Inundation in the spring after harvest and before the new crop season opens is a new aid in protecting the holts from insects and in fertilizing the sets especially advised by the Bureau.

A valuable part of the bulletin is a chapter on insects injurious to basket willows, prepared by the Bureau of Entomology. This not only describes the insect enemies of the willow, but



MACHINE FOR BUNDLING WILLOWS FOR MARKET.



DIFFERENT KINDS OF PEELED AND UNPEELED WILLOW SHIPPING BASKETS ON THE DOCK AT ROTTERDAM, HOLLAND.

also gives methods for their control. The bulletin should prove invaluable to all present producers and manufac-

urers of basket willow, and of great interest to farmers who desire to add willow-growing to their other crops.

CONTROL OF THE KANSAS RIVER FLOODS

TREE PLANTING ADVISED BY THE BUREAU OF FORESTRY—LAST YEAR'S LOSS OVER \$20,000,000.

THE Kansas River floods have called new attention to the methods recently advocated by the Bureau of Forestry for controlling the course of the stream and for repairing the damage to inundated farm lands. The high-water mark this summer is 10 feet lower than that of last season, nor is the property loss comparable to that of a year ago, when the damage wrought exceeded \$20,000,000 and when over 100 lives were sacrificed. But in permanent injury to the productive capacity of the region it may well be said that the river has delivered a second blow as serious as was the first. The flood of 1903 was the greatest since 1844. Until a year ago the valley of the Kaw was as fertile as any on this continent. For centuries the strips of

woodland along the banks of the river bed impeded the rush of overflows, and the silt that built up the rich land had been precipitated. But under agriculture the trees were gradually cut down, in many cases right to the water's edge. The result was inevitable. In its natural course the river runs rather slowly and with many windings through its flat meadows. But when it overflowed the water swept straight down the valley. Unimpeded by trees, it increased its velocity, in some places cutting for itself new channels, and for almost the whole 120 miles of the valley not only deeply eroded the river banks, but played havoc with the valuable farm lands. In some places the rich soil was cut away to the barren sands or gravels; in others coarse sand was laid 6 and 8



RAILROAD TRACK ON TOP OF COAL CAR, NEAR LAWRENCE, KANSAS.



VIEW OF MISSOURI PACIFIC RAILROAD BRIDGE AT KANSAS CITY AFTER THE FLOOD.

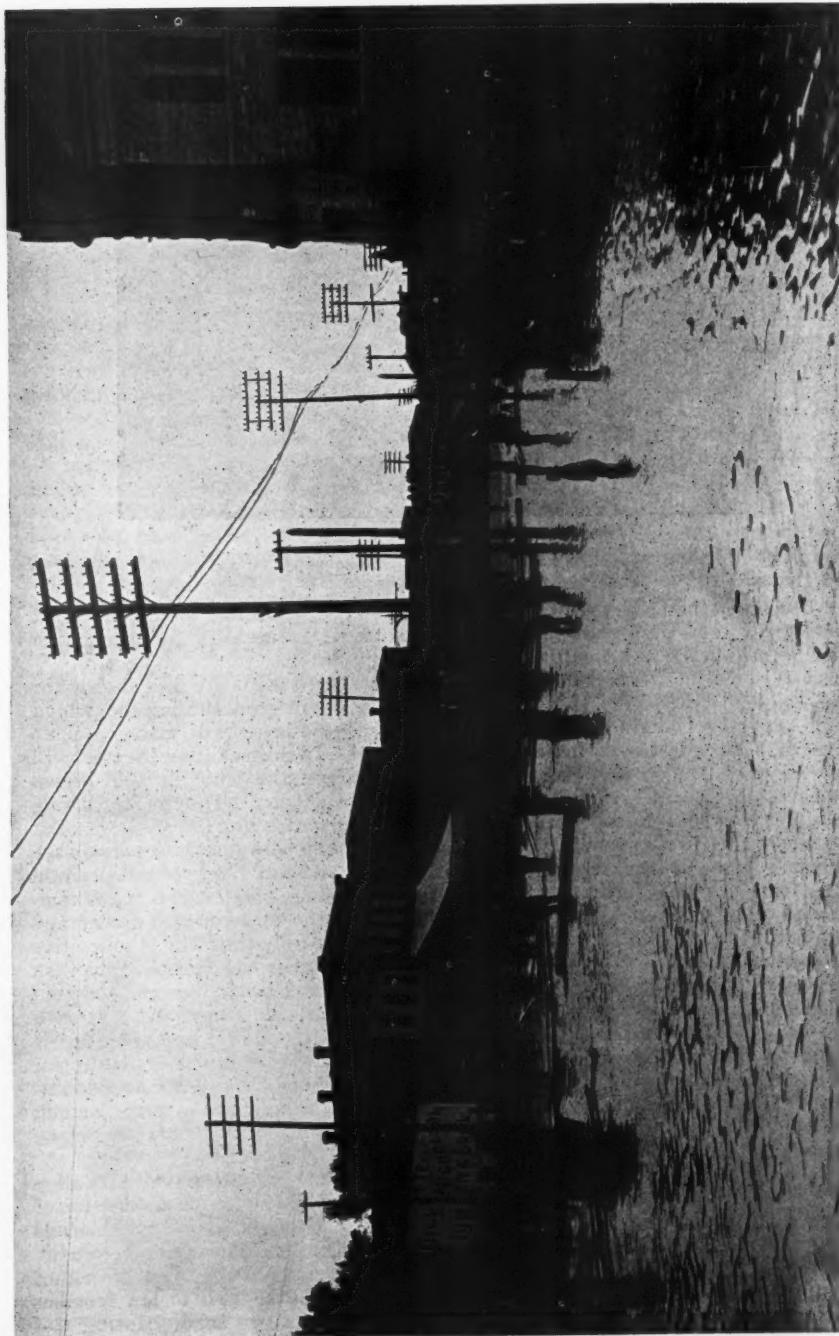
feet deep over the fields; in still other places great holes were gouged out and lakes formed acres in extent. Of the 250,000 acres of remarkably fertile lands, worth from \$100 to \$250 an acre, which the valley contained, 10,000 acres were completely destroyed for agricultural purposes, 10,000 acres more were damaged 50 per cent of their value, and the whole area was greatly depreciated in value owing to the general sense of uncertainty as to the future. That these fears for the future were well-founded the repetition of the disaster makes sufficiently plain.

But the condition of the citizens of the valley is far from hopeless if they will put into active and general operation plans for the protection and reclamation of their lands. The Bureau of Forestry has devised systems of tree planting for the river banks, the sand-covered lands, and the deeply eroded lands. The object of the first is to prevent washing of the banks, to protect the whole area from the full force of floods, and in time of overflow to check the tendency to gully and cut new channels. The last two systems of planting are for ultimately reclaiming the now destroyed lands, and making them pro-

duce in the meantime a valuable wood product while the work of reclamation is going on.

The sanded lands are now useless for crops, but will grow cottonwood, which twenty years hence will make valuable saw-logs. In the meantime the trees will be reclaiming the land for field crops. This they will do partly by the fertilizing effect of the decaying forest litter. But should the flood waters return again the timber would very likely be in a position to render much greater service. Examination of the area affected a year ago shows strikingly that where protective growths of cottonwood checked the rush of the current, the land beyond was generally covered, not with sand, but with silt, and is often, if anything, more fertile than before. With extensive planting of forest trees another flood would undoubtedly bring back at once to fertility much of the land which has now been made barren.

The lower part of the Kansas Valley was devoted chiefly to the production of potatoes. Crops of 300 to 400 bushels per acre were not uncommon before the flood. Thousands of acres of potato fields were buried two to six feet beneath coarse river sand, causing the



Courtesy Weather Bureau, U. S. Department of Agriculture.
BUILDING PONTOON BRIDGE AT TOPEKA, KANSAS, FROM ROCK ISLAND DEPOT TO SOUTH APPROACH OF MELAN BRIDGE.

farmers to abandon much of this land. Of 1,000 acres of once valuable sweet-potato land in one body near Wamego, Kansas, only 35 acres were cultivated last year after the flood, and this is probably all that will be fit to cultivate for many years to come.

The Bureau of Forestry is now sending to the citizens of the Kaw Valley a mimeographed circular of recommendations for guidance in forest planting on their damaged lands, in which it is said:

"Wherever the river has changed its course and straightened its channel, every possible effort should be put forth to keep it straight. Much of the damage that was caused in the great flood of 1903 is directly traceable to crooks in the stream. The soft, bare banks should be covered with willows at the earliest possible moment to prevent the stream from again becoming crooked. In addition to the protection of the caving river banks and the reclamation of the sanded

and eroded lands, the land-owners of the Kansas River Valley should immediately coöperate to secure continuous belts of timber 250 feet wide on both banks of the stream. Such protective belts will be far more serviceable than dikes of earth or masonry in mitigating the destruction that may occur from overflows. The future wealth and productiveness of the valley as a whole will be largely dependent upon the practice of forestry for protection against devastation by floods."

The conditions are peculiarly favorable for the success of tree planting in the flooded regions. The flood prepared an excellent seed bed for trees, and willow and cottonwood seedlings are growing thick on ground that was too wet to plow last year. The young cottonwoods can be taken up and set out on the sandy ridges which the flood has damaged. Thus the nursery stock will cost nothing but a little labor.

FORESTRY AT THE UNIVERSITY OF MINNESOTA.

A FULL FOUR YEARS' COURSE OFFERED AND DEGREE CONFERRED UPON ITS COMPLETION.

WARRANTED by the success of former forest work and instruction in forestry which has been carried on at the University of Minnesota for the past 14 years, and in response to an urgent demand for it, the course in forestry in the College of Agriculture, University of Minnesota, was established in 1902, when a change in the curriculum was taking place. This is a full four years' course, parallel with the courses in other departments of the University, and leads to the degree of Bachelor of Agriculture in Forestry. It is intended to prepare men to take charge of independent forest properties, or for the government forest service, or for positions as teachers.

The location of a school of forestry at the University of Minnesota is most suitable because of the many natural advantages, easy access to a timbered

region, giving an opportunity of studying lumbering operations, the use of a well-equipped university, agricultural college, and experiment station, and the varied auxiliary forest industries centered in a large lumbering city. The Minnesota National Forest Reserve in north central Minnesota offers excellent opportunity for observing the best methods of forest management conducted by the Bureau of Forestry. The Minnesota Forest Reserve Board has recently acquired 20,000 acres, and on another tract of 1,000 acres has established a nursery and commenced the growing of seedlings for forest planting.

Opportunities are here offered to see, and in many cases to take part in, the scaling and estimating of timber, and to work in lumber camps for good pay at practical lumbering operations.

The city parks, nurseries, sawmills,

wood and furniture factories, creosoting works, and the state fish-hatchery in and about the city of Minneapolis are available for study at all times. Examples and practice in horticulture and forestry on the Experiment Station grounds can be observed throughout the whole year. Practical instruction in tree planting and in nursery work is offered in the arboretum and forest garden of the University farm. Native woodland on the farm and virgin forests nearby afford opportunity for practical demonstration in forest mensuration, silviculture, and forest botany.

A well-equipped library of the best works on forestry, the leading forestry and lumbering journals, and all the state and government publications bearing on the subject is a special feature of the department of forestry.

Reference and research work in forestry are well provided for. Forest instruments and material for the practice and study of forestry are quite complete for a new forest school.

A very desirable arrangement is that the student may take university subjects in connection with studies in the College of Agriculture. In botany, zoölogy, entomology, chemistry, physics, geology, surveying, political economy, law, and rhetoric the student has all the advantages of a large and well-equipped university.

The following from the college catalogue descriptive of the course will furnish an idea of the plan of instruction and show the emphasis laid upon practical work:

The first year in the course for those who enter other than from the Minnesota School of Agriculture deals with the elementary agricultural subjects that it is important for every manager of rural properties to be familiar with. The forester, from the very nature of his surroundings, will be largely thrown on his own resources, and should be capable of advising as to the best way of managing the farms or grazing lands that are almost always included in large forest properties. The sophomore year and one-half of each of the junior and senior years are devoted to the study of

the basal natural sciences underlying the practice of forestry, and to such academic and engineering studies as seem especially desirable here. While French is made optional with German, it is expected that German will be taken in most cases, as it is the most helpful language for those who are to study forest literature. An opportunity will be afforded to take Spanish, as it may be especially desirable to those who contemplate entering the Philippine forest service. One-half of each of the senior and junior years are devoted to the study of technical forestry, an important part of which consists of field work and excursions. Every student is required before graduation to take four weeks' work in some approved lumber camp, so as to become familiar with common lumbering operations.

Especial emphasis is laid on the value of field work and excursions. This consists of excursions to nearby forests; to lumber camps, sawmills, and wood-manufacturing and paper mills; to the Boom Company's works on the Mississippi River; to nearby nurseries, and it is expected that arrangements will be made which will afford an opportunity for students to visit some of the forests of Montana, Idaho, and Washington at a very low rate. Excursions are also frequently made in connection with the study of botany, geology, zoölogy, and nursery practice.

OUTLINE OF COURSE IN FORESTRY.

Freshman Year.—Students entering the forestry course will be required to take the freshman year the same as other students of the college of agriculture.

The Department of Agriculture.

SOPHOMORE YEAR.

First Semester.

Botany, short (4).

Chemistry (4).

German or French (4).

Agricultural Physics (2).

Rhetoric (1).

Military Drill (2).

Second Semester.

- Botany, short (4).
- Surveying (4).
- German or French (4).
- Trigonometry (4).
- Agricultural Physics (2).
- Rhetoric (1).

*JUNIOR YEAR.**First Semester.*

- Botany, Taxonomy (4).
- Forest Entomology (4).
- Forest Influence and Utility (2).
- Forest By-products (2).
- Forest Mensuration (2).
- Lumbering (2).

Second Semester.

- Plant Ecology (4).
- Law, elements of contracts (1).
- Zoölogy (4).
- Wood Technology and Diseases of Wood (4).
- Forest Valuation (2).
- Silviculture (2).

*SENIOR YEAR.**First Semester.*

- Geology, I (4).
- Silviculture (4).
- Elements of Economics (4).
- Vegetable Pathology (4).

Second Semester.

- Geology, III and IV (4).
- Forest Economics (4).
- European Forestry (1).
- Forest Administration (2).
- Forest Protection (2).
- Fish Culture, Game Protection (lecture) (1).

Thesis, seminary in reading forest literature (2).

Four practicums are required in the course in forestry, viz: in forest exploitation, forest working plans, forest mensuration, nursery practice. A thesis must be presented in each of the four subjects, giving the results of personal observation.

The above outline gives the number of class-room hours per week for each study; the whole number of hours for a period of a week, exclusive of laboratory work, amounts to between sixteen and seventeen hours. The laboratory hours and field work in the subjects requiring it are reckoned at double the class-room period.

In addition to the scheduled course indicated above there will be lectures by the Chief Fire Warden, the State Game Warden, and a number of prominent lumbermen of St. Paul and Minneapolis.

EFFECT OF FORESTS ON WATER SUPPLY.

BY

T. P. LUKENS,

BUREAU OF FORESTRY.

THE effect of forest fires on water supply in the southern California forest reserves, forest clearing and the water flow in streams and springs, and the relative flow from timbered, chaparral-covered, and bare watersheds are problems of vital interest to our people. We have at hand so many illustrations covering all of these features that I hardly know where to begin. I think the most striking demonstration of the

loss of water supply through forest fires is in the San Gabriel Reserve. The San Gabriel River drainage basin comprises an area of 222 square miles. In 1901-'2, after five successive dry years, the minimum flow in the San Gabriel was 90 miner's inches. For the same period the San Antonio River drainage basin, with an area of 26.7 square miles, furnished as a minimum 190 miner's inches.

There being such a great discrepancy

in-supply based upon the area, I determined to investigate and ascertain, if possible, the cause. The San Gabriel River drains the very center of the reserve, its west and easterly arms reaching out fully forty miles east and west, with the central channel leading to the valleys of about twelve miles. It is in a position to receive the maximum rainfall, as it is generally understood that in the higher elevations and the central portion of the mountains the rainfall is far greater than on either the valley or the desert slopes. I traversed the entire area, skirting up into the canyons, and I found no place where fire had not burned within a comparatively few years. In many cases the stream beds even were denuded.

One tributary of the East Fork of the San Gabriel, known as the Devil's Canyon, with an area of thirteen square miles, was formerly noted for its fine timber and continuous flow of water. The average altitude of this canyon is about 4,000 feet. Formerly sheep grazing was carried on in this basin, and the inevitable accompanying fires literally destroyed all vegetation, until now there is no conserving power whatever. In fact, nearly the entire area of the San Gabriel River basin has been seriously burned, and in these regions that have been burned so frequently and so severely there is nothing but rocky surface, and it will require very many years for the growth to return. There is perhaps one-third of the entire area that



WESTERN YELLOW PINE FOREST IN SOUTHERN CALIFORNIA.



SCENE IN SAME FOREST ONE WEEK LATER, SHOWING LOPPINGS LEFT AFTER CUTTING; A PERFECT FIRE TRAP.

has not been burned for about twenty-five years.

On the other hand, the San Antonio River basin is contiguous, heading in the San Antonio Mountains, running south, thus receiving the precipitation from the south, east, and west slopes. In this area I found that perhaps one-half of the entire area had been burned within the past fifteen years, while the balance of the area showed little signs of fire. Notably in Bear Creek, with a drainage area of about seven square miles, the timber and chaparral growth was remarkably fine and the humus cover very good. There were no evidences of a quick run-off in the way of débris and scarred trees and but little variation in the stream flow during the entire summer. These two watersheds, if they had been cared for the same—or, in other words, if the fires had been kept out of each, there is no reason why the minimum flow should not have been exactly the same per area. The geological formation of one is identical with that of the other, and in point of geographical position the San Gabriel would

have the advantage, because it takes all of the north and west drainage of Mt. San Antonio, which has an elevation of 10,500 feet, on which the snow would melt very slowly and the run-off would be much more deliberate.

Now, as to the benefit of a stream cover. A few years ago I was with Mr. Joseph Lippincott and another engineer in the country drained by the San Gabriel, at which time we traversed all of its branches. They were making scientific measurements, and I was studying particularly the effect of forest cover on run-off. Mr. Lippincott, at my request, made measurements of the water at the intersection of the West Fork and at a point four miles up the river. This portion of the river and the seepage beds on either side were well covered with willow, alder, and other trees, so that the wind and sun rarely reached the water. Their measurements showed an increase of 38 miner's inches of water in the four miles, showing the great advantage of tree protection to the water flow. Above this point there is a stretch of six miles,

on which there is but little covering, being very rocky and bare. The engineers did not have time to take measurements there for me, but I made them myself as carefully as I could, and I found in the six miles there was a shrinkage of over 20 miner's inches. This certainly was proof to me of the great value of stream covering. During the past summer, while we were gathering spruce seed on the Santa

to be imperceptible. During this period the weather was very warm and clear, and the flow of the stream had declined only one inch in six weeks. Further down the same stream the slopes of the mountain and the stream cover were entirely burned by fire in 1900, doing a vast amount of damage. Extending up the stream for six miles from its mouth, the covering was entirely gone, and there I took measure-



VIEW IN SAN GABRIEL REGION OF SOUTHERN CALIFORNIA, WHERE ONLY SMALL BRUSH IS LEFT ON IMPORTANT WATERSHEDS. FORESTS SWEEP AWAY BY RECKLESS CUTTING AND FIRE.

Anita Creek, in the San Gabriel Reserve, I had measurements taken by weir in the morning at seven and in the afternoon at four o'clock. Above this point three miles, toward the head of the stream, there is the most perfect covering for both stream and watershed that we know of in southern California, consisting of big-cone spruce and oaks on the slopes, while the stream is covered with alders and maples. We found the variations between morning and evening measurements so slight as

ments for a few days and found the variation between morning and evening was from 35 to 50 per cent loss in the six miles.

This is quite common. I could go on and give many such instances of loss of water through the destruction of trees and chaparral by fire. Even where watershed areas are well covered, if the stream is exposed to the wind and sun in this hot, sunny climate, the loss is very serious. The relative fall from the timbered, chaparral-covered,

and bare watersheds is very striking. The flow from our timbered watersheds is slow and continuous; from the chaparral-covered areas a greater variation, quicker run-off, and a much less run-off than from the timbered areas in the latter part of the season, showing that less water has been conserved and a greater evaporation has taken place. Bare watersheds on our steep mountain sides retain practically none of the precipitation, but allow it to run off with a rush, eroding the mountains and depositing vast quantities of débris in the valleys.

I will give one more illustration of the great damage to water supply by fire.

Near Pasadena there are two small canyons, from which some years ago an equal amount of water was flowing, being conducted in iron pipes. About 1885 a fire swept over the drainage of one of these canyons. The water supply from this burned canyon decreased immediately, and the season after the fire it ceased to flow entirely. As the chaparral and trees came back the water reappeared, until now the supply, while not equal to the original flow, is on the increase. The water in the canyon that was not burned continued to flow. These canyons are very near together on the south slope of the San Gabriel Reserve.

FOREST FIRES.

THE northwest has been the principal sufferer from forest fires during September, although in most cases not the same territory as that laid waste by the fires mentioned in our last number.

Oregon.—Oregon appears to have suffered more severe loss than any of the other states from numerous fires throughout its area, the most destructive of which was perhaps that near Holbrook, where the loss exceeded \$13,000, according to newspaper reports. This fire gained headway early in the month, and at about the same time the Bull Run Forest Reserve was threatened by a forest fire in the vicinity of Mt. Hood. On September 10, newspaper reports indicated the presence of two blazes in the vicinity of the Cascade Forest Reserve, and by September 17 it was reported that they had inflicted considerable damage to the magnificent timber in that section. After smouldering for several days a fire broke out two miles southeast of Gresham, and in its course toward the Clackamas River destroyed a number of farm buildings and cut and standing timber. A forest fire between Manning and Buxton inflicted damage, and in the vicinity of Clatskanie, Columbia county, scattered fires threatened considerable damage

until extinguished. As late as September 18 it was reported that 3,000,000 feet of green timber had been destroyed along the Sandy River near Ames.

Washington.—After being practically extinguished, the forest fire at Fourth Plain, which, as stated in the September number of FORESTRY AND IRRIGATION inflicted considerable damage, broke out again with renewed vigor, and devastated the country in that vicinity until it was again found necessary, on September 17, to detail soldiers from the Vancouver Barracks to assist in quelling the flames. A continuation of the last month's fires in Pierce county also destroyed property in several localities, and a fire on the headwaters of the Puyallup River shut off all electric power in Seattle for several hours, owing to the destruction of power transmission poles from the power company's plant at Electron. At La Grande, in Thurston county, in a practically unexplored and impenetrable country, forest fires were reported on September 8 to have done considerable damage. Incendiarism is supposed to have been the origin of a forest fire on the Kalama River, which destroyed a large amount of green timber. It is estimated by Seattle newspapers that a loss of \$6,000 in city timberlands was incurred through

a forest fire in the vicinity of that city. A fire reported on September 16 at the head of Lake Washington burned over 7,000 acres of land and destroyed 200,000 feet of lumber, besides burning a logging camp. State aid was extended the Weyerhaeuser Timber Company, and the Cole Shingle Company in fighting fires in township 13 of Pacific county.

Montana.—Newspaper reports indicate that 100,000 feet of lumber have been burned by a forest fire which, on August 25, was making headway toward Saw Tooth Canyon. The forest fires prevalent near Kalispell, mention of which was made in the September number of FORESTRY AND IRRIGATION, have practically been extinguished. The losses are said to have been over \$25,000 in timberlands alone. On August 30 forest fires of considerable magnitude were reported at the head of the Bitter Root Valley, and a blaze in the Deer Creek country, near Big Timber, on lands adjacent to and within the Absarokee Forest Reserve, burned over some valuable pine and fir timberlands. Rain on September 22 practically extinguished forest fires to the west of Anaconda, which had been burning with considerable damage to timber, mining, and quarry property since September 13. Another fire east of Anaconda, presumably started by careless campers, was checked by dynamite after large damage. North of Missoula, on the Rattlesnake, a forest fire is reported to have inflicted loss, and fires extending from the Idaho line to Trout Creek delayed Northern Pacific trains and did minor damage to timber.

California.—A large number of forest fires, some of considerable magnitude, devastated California throughout its area. Most of these occurred from September 7 to 14. Probably the most serious of these fires started early in September in the Santa Cruz Mountains, and newspapers report the loss of three lives and \$100,000 in property, exclusive of extensive damage to timber. Several valuable hotels and summer residences were consumed and much standing timber destroyed in a forest fire that swept from Bolinas Ridge to-

ward the head of Lagunitas Canyon. In Redwood Canyon a bush fire of minor importance developed into a fierce blaze which did considerable damage, placed by newspapers as high as \$75,000. In Alameda and Contra Costa counties it is said that losses will aggregate thousands of dollars, while in Marin county 14,000 acres are said to have been devastated, entailing a large property loss and threatening the destruction of several villages. Fires in Amador, Plumas, and Tehama counties are said to have caused no small damage, while in the Big Basin, in Santa Cruz and Santa Clara counties, a big blaze laid waste a large territory, and for a time threatened the destruction of the famous Big Basin Park. A large area of pasture has been burned over in Monterey and San Luis Obispo counties; at Cohasset, Butte county; in Sonoma county, near Santa Rosa; in Yolo county, to the west, and in Yuba county, in the Strawberry Valley section, considerable damage has been done. The *Sacramento Bee* estimates a total loss of about \$35,000 from forest fires in the Santa Lucia Hills, near Salinas. A fire at Keswick, California, caused a property loss estimated at \$10,000. Flames swept over Eddy Mountain, in Siskiyou county, doing much damage to valuable timber, and the southern part of Humboldt county is said to have been laid waste. Near San Bernardino, in the vicinity of the famous Arrowhead, forest rangers had difficulty in quelling forest fires.

Idaho.—At Rathdrum, Kootenai county, a high wind fanned a small forest fire into a destructive blaze, which entailed considerable loss. At Spirit Lake, a summer resort 40 miles from Spokane, Wash., considerable damage is reported. At Cœur d'Alene City, also in Kootenai county, some loss was occasioned.

Minnesota.—A forest fire started on August 28 in the dead timber and slashings near Park Rapids and caused considerable anxiety as to its probable result to the town.

Newfoundland.—A continuance of the destructive fires in this province has inflicted large damage. Canadian

papers place the loss as high as \$20,000,000 incurred so far this season. The hamlet of Little Bay was destroyed and two men were killed by a forest fire on August 31.

British Columbia.—It is estimated by prominent lumbermen that \$500,000 loss in timber alone has been occasioned by mid-island fires near Vancouver, and the property loss has been considerable.

Nearly every district in the province has suffered some, and nearly all the government reservations have been visited, with more or less serious consequences. On Howe Sound, in the vicinity of Vancouver, a number of lumber camps, some standing timber, and many thousands of shingle bolts were burned, and it is also reported that four persons succumbed to the flames.

FORESTRY AS APPLIED TO THE DEVELOPMENT OF KANSAS.

BY

GEORGE W. TINCER.

To any one who has studied the forest conditions of Kansas, with its meagre supply as compared with the total area of the state, there can be but one conclusion, namely, practically all of the lumber for building purposes must be shipped from adjoining states, and a large portion of the post and pole stock to be used by the farmer must come from the same source. It is true that certain localities in the eastern part of the state, along wooded streams, have an abundance of native timber for local use on the farm, in the way of posts, poles, and fuel; however, only a small portion of the state is so favorably situated. Many of our most productive counties are entirely treeless, and all the timber and fuel must be shipped from the outside. We receive posts from Arkansas, Missouri, Minnesota, and Wisconsin. This is a great drain on the people, because of the excessive freight rate, which is added to the net cost of such stock. Many of the older portions of the state are now using posts and poles that have been grown in the immediate neighborhood. This is a step in the right direction, and one which will have to be followed out, because the demand for all such stock in other parts of the country is becoming great, and the prices will thereby be advanced. I can see only one solution

of the timber problem, so far as posts, poles, and fuel are concerned, and that is to grow them on our own soil and in the locality where there will be the greatest demand.

THE NECESSITY FOR ARTIFICIAL FORESTS.

There can be no doubt about the necessity for establishing artificial forests in Kansas, because of the meagre supply of our native timber. Any experienced farmer who has grown timber of any sort to a sufficient size to be used for posts or poles knows that it is much cheaper and more satisfactory for him to go into a grove and cut the stick desired than to go to a lumber yard and pay cash for the same material.

From fifteen to twenty years ago many artificial forests were established in Kansas. The catalpa is the tree that has been planted more than any other. Some of these forests have not proven a profitable investment, because of the inexperience of those who handled them. The others have paid the owners a larger rent for the ground than they could have secured from any other crop. The Yaggy forest, located near Hutchinson, consists of about five hundred acres of catalpa. The first planting was done in 1890. Posts have been cut from this forest for the last four years,

and the owners do not hesitate to say that it is one of the most profitable crops they ever grew. This forest is located in a treeless district of the state, where there is a ready demand for any supply that may be grown. Many other tree growers can testify to the same fact that applies to the Yaggy forest.

Every land-owner should have a certain portion of his land devoted to forest growth. It would be wise and profitable to reduce the size of the orchard and plant a timber belt on the south and west sides of it. In all probability the owner would procure more fruit from a smaller number of trees that were situated within this sheltered belt, to say nothing of the income received from the forest trees.

An additional reason why artificial forests should be established is that we believe that during the next twenty years Kansas will enjoy her greatest growth. This growth will call for an increased supply of young timber, to say nothing of constant renewals that must be made. All of the present pastures in Kansas will have to be renewed during this time, and the increased acreage of corn, wheat, alfalfa, and other crops will cause the subdividing of many of the large fields of the present day. The demand for small country telephone poles will be much greater than any supply that will be grown. The telephone is one of the things that has come to stay. Every resident of the rural districts will not be content without local telephone service. The dairy interests alone in central and western Kansas will call for millions of posts and poles for fencing and shelter. During this twenty years the present prices will be increased all the way from 25 to 50 per cent, and it seems to me the height of folly to pay this additional cost when we can grow the same material on our own ground and keep the money at home.

LOCATION AND THE BEST SPECIES TO PLANT.

The location of a timber plantation is an essential feature. It should be located where the greatest demand will be when the timber is grown. It would be unwise for a man to plant a timber forest

in the sparsely settled region of Arkansas or in the heavily wooded districts of Wisconsin, but the broad, fertile prairies of Kansas, where the wheat and corn belts come together, is an ideal location in which to grow timber, for the reason that long before this timber is large enough to be used, there will be a demand for it. This would be a good location for the reason that when the product is put on the market the matter of freight will be cut down to a very reasonable rate.

Bottom land will grow trees to a merchantable size in a shorter period than prairie soil. However, we must take into consideration the difference in the price of bottom land and the prairie land. We must also consider that many counties of Kansas have no bottom land, and if the trees are grown at all it must be upon high open prairie.

The Bureau of Forestry, at Washington, D. C., has issued bulletin No. 37, entitled "The Hardy Catalpa," written by Mr. William L. Hall. This bulletin gives an immense amount of information, and deals entirely with catalpa plantations in Kansas. It should be in the hands of every land-owner in the state.

For the eastern half of Kansas I would select catalpa (*speciosa*) in preference to all other timber trees, because this tree has been more thoroughly tested than any other variety. It has more good qualities and less objectionable ones than any tree I know of. It will produce first-class posts in from ten to twelve years, and poles a few years later, while it is almost indestructible in contact with the soil. It is easily worked, will hold staples perfectly, and is tough and strong.

For the central and western part of the state I believe the Russian mulberry, Osage orange, black and honey locust will prove to be quite a factor in the post problem of the future. These trees will grow where it is almost impossible for others to live. They will grow to a suitable size for posts in a dozen years. The mulberry and Osage orange, in order to produce an upright growth, must be pruned annually until the stem is of sufficient length to make a post. Much

of the sand land of southwestern Kansas seems to be admirably suited for the growth of these trees. The black locust is one of the best trees to plant in any part of the state if it was not for the attack of the borer, though in some localities it seems to be immune from this pest.

Mr. Royal Kellogg, of the Bureau of Forestry, has prepared a bulletin, that will soon be issued, on the trees adapted for that part of Kansas and Nebraska west of the one hundredth principal meridian. This publication will be especially valuable for all residents in the western part of the country. The red cedar will thrive to the Colorado line and can be used for ornament and a windbreak, but for post and pole purposes it should be at least from twenty-five to thirty years old, on account of the large proportion of sap as compared with heartwood, the heart being the only portion of the wood that will resist decay. The proportion of sap as compared with heartwood in the mulberry, Osage orange, catalpa, and locust is quite small.

The Austrian, Scotch, and other pines will grow in the West if one has patience and understands how to start them and give proper care and cultivation until they become firmly established.

WILL IT PAY?

Every man who plants trees—or anything else—naturally asks the question, "Will it pay?" I believe that by a

judicious selection of location and the species of trees planted, and with proper care, a timber plantation will pay a larger rate of interest on the investment than the average farm crop. It is true that if every owner of land planted it to timber the profits would be very much lessened; but only a small proportion of men will plant a crop for which they must wait from ten to twelve years to realize a profit. The greatest profit to be derived from an investment of this sort is that it is permanent. When a plantation is once established and the crop is removed, a second crop can be grown from the stumps in much less time than the first and produce a better grade of timber than the first one. The Osage orange and catalpa are the most persistent sprouters on the list.

It will pay not only in a financial way, but it pays in the sense of being a benefit to the community in which one may live. It will pay as a shelter for hogs or cattle from the cold northwestern blizzards that sweep over the state annually. It will pay many times the cost by providing shelter for a herd of cattle during one of these terrible storms. From my experience of almost twenty years in growing timber trees, I feel perfectly satisfied that it has paid me; and if I had the means, I would plant one or two thousand acres to forest trees within the next few years, because I firmly believe that long before 1920 every owner of timber will find a ready market and a good price for anything that he may offer for sale.

TRACK SUPPLIES AND TREATED TIMBERS.

NEW FORM OF RAILROAD TIE RECOMMENDED BY THE BUREAU OF FORESTRY.

THE annual consumption of ties on 203,132 miles of railroad track in this country is 114,000,000, and it is yearly becoming harder to meet this demand. Granite, metal, and, more recently, concrete ties have been experimented with, but nowhere permanently adopted, and the indications are that wooden ties are not soon to be displaced.

The Bureau of Forestry has for some time been making studies and experiments designed to improve the present conditions and to prevent the exhaustion of the timbers from which ties are made. Bulletin No. 50, "Cross-Tie Forms and Rail Fastenings, with Special Reference to Treated Timbers," by Dr. Hermann von Schrenk, which has

just been published, gives the latest results of these investigations.

The manner in which ties have hitherto been made has been determined largely by the ease and rapidity with which they could be cut. They have been obtained from trees of all diameters, from 9 inches upward, the most serviceable portions of live straight trees being selected. The sapwood top sections and trees killed by fire, insects, disease, etc., or blown down, could not be utilized, owing to the fact that ties from sapwood or dead timber decay rapidly.

Although large ties make a better roadbed than the same amount of timber in a greater number of small ties, the first consideration is to have as great a bearing surface as possible on the ballast. A trapezoidal or modified half-round tie, with a base of 10 to 12 inches and a top-bearing surface of 6 inches, distributes the weight of moving train loads upon the roadbed as effectually as a rectangular tie 10 to 12 inches broad. The half-round tie is good for the lumberman, because in numerous instances two ties of this form can be made from a log which would furnish but one rectangular tie; in other cases material for several boards is saved where a rectangular tie would have taken the entire log. This form is beneficial to the forest, since it encourages the cutting of large trees and the saving of small ones until they reach more valuable size, and permits the utilization of much timber from the tops, hitherto left in the woods. The half-round tie is advantageous from a mechanical standpoint also, because it gives greater bearing surface per mile and a correspondingly more stable track than rectangular ties. This tie form is therefore advocated by the Bureau of Forestry as economical of timber, conservative of the lumber supply, and at the same time equally efficient with the forms in common use.

Ties are commonly graded as first, second, and third class, and culls, or ties which either in size or in quality fall below the specifications, but which the railroads generally accept up to a certain percentage of the total number of ties, though at a greatly reduced price.

There is, however, no accepted standard as to what constitutes a first, second, or third-class tie, and the specifications of the various railroads show wide differences in the dimensions required. It is proposed by Doctor von Schrenk that a standard classification be adopted, consisting of six or more classes, to be known as A, B, C, etc., each class to be of a definite size, and no provision to be made for culls. This will tend to economy, since the smaller-sized ties will fall into the smaller classes and will be sold at their market value to the roads which want them, instead of, as largely now, to roads which do not want them, but, having received a certain proportion of them mingled with those of the specified size, do not feel warranted in rejecting them altogether. This proposal has been adopted by the American Engineering and Maintenance of Way Association.

A far greater economy, however, than can be hoped for from the adoption of a new tie form or a new tie classification is that promised by the studies which the Bureau of Forestry has directed toward opening new sources of supply of ties. This it aims to do by making possible the utilization of cheaper and more abundant kinds of timbers in place of the high-grade woods now employed. The commonest as well as the best tie material of the past and present in this country is white oak, which resists both wear and decay excellently, and is consequently cheaper in the long run than less expensive woods like beech, red oak, or loblolly and lodgepole pine; but white oak, besides being one of our finest timber trees, is becoming high-priced, and further, as railroad men know well, is becoming scarce even faster than the advancing price would indicate. Not only is it very wasteful to make ties of white oak, which can be manufactured into much more valuable products, if a lower-grade wood will do, but soon, under the present demand, white oak ties will no longer be obtainable in the required quantity at any price.

The first step in the search for substitutes was to discover how to prevent rapid decay of softer woods when laid in the track. Preservative treatment

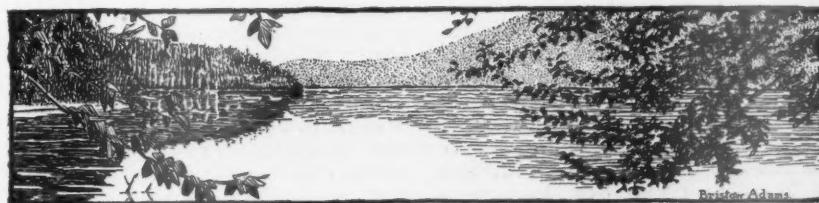
has long been in general use abroad. With proper methods it can be made entirely successful, and impregnation with creosote, zinc chlorid, or other antiseptic substances allows the use of many woods hitherto passed over, as well as of sawed ties, sapwood, and dead timber. Preservative treatment can make a beech or red oak or pine tie outlast a white oak tie. But the wearing away of the softer fibers of these woods under the rail and around the spike raises a new set of problems. Even with cheap treatment practicable, which insures against the destruction of the tie in the ground by decay, it is neither economical nor safe to equip a road with such ties unless mechanical devices can be found which will prevent rapid wear. Ties chemically treated resist decay, but the softer woods can not withstand wear of the rails nor hold the spikes under the heavy traffic of American roads.

This is true not only of ties upon which the rails rest directly, but also where the old forms of steel plates inserted between rail and tie are used. Indeed, the thin plates with prongs or spines and flanges, hitherto generally used in the United States, appear to hasten rather than retard wear of the tie. With accompanying screw-spikes, which hold the rail firmly to the tie, several forms of plates can be introduced successfully. Wooden tie-plates can be used, which, when worn out, are easily replaced.

The functions of spikes are, first, to hold the ties to the rails, and, second, to prevent the rails from spreading. Nail spikes are still used for this purpose in this country. In driving a spike into a

white-oak tie the strong and elastic fiber of the wood is bent downward, maintaining a close contact, so that powerful resistance is offered to its withdrawal. When driven into such woods as hemlock and western yellow, loblolly, or shortleaf pine, the fibers of the wood are crushed and broken. As a result the spikes do not hold with sufficient firmness to withstand the undulatory motion of the rail nor the lateral pressure against them. They become loosened, and the constant friction enlarges the spike-hole until water collects in it and decay begins. The spike must soon be driven in a new place, and this constant respiking rapidly ruins the tie. Even if the tie has been treated with a solution like zinc chlorid, the water will leach out the salt, so that decay-producing factors begin their work. The solution of this difficulty is achieved by the use of a screw spike. In the soft woods screw spikes will resist nearly three times as great a strain as nail spikes. If inserted in a screw dowel of hard wood, the power of the screw spike is still greater. A key operated by two men, a hand-power screw-spike-driving machine, or a machine with electric power may be employed to insert screw spikes.

Arrangements are being made for the extensive introduction of these appliances, the need of which has developed so conspicuously in the brief experience with treated timbers. If in the maintenance of a stable track, so indispensable for the safety of trains moving at a high rate of speed, the proposed equipment fulfills the promise of experimental tests, an important step in the better utilization of our forest resources will have been made.



THE RANGE PROBLEM.

A DESCRIPTION OF THE STOCKMAN'S HOMESTEAD
AND GRAZING RANGE ADMINISTRATION IN THE
WEST, WITH SUGGESTIONS FOR ITS IMPROVEMENT.

BY

PROFESSOR R. H. FORBES,

DIRECTOR OF ARIZONA AGRICULTURAL EXPERIMENT STATION.

THE industrial condition which governs throughout more than 400,000,000 acres of western public grazing lands has been described many times recently in articles discussing the question of the proper disposal of these lands. In general, the situation is everywhere the same, temporary occupation without ownership or legal possessory rights by stockmen of that public domain whose purpose is to provide room and opportunity as long and as fully as possible for the nation's rapidly expanding population.

Mindful of such an important utility for our public lands, any damage to the national asset must be considered, virtually, as a sacrifice of national territory, inasmuch as its impairment means the loss of so much foothold and working room for prospective settlers. Yet exactly this has been the result of the misfit application of existing land laws to western conditions. These laws, virtually inoperative in a grazing country, have necessarily been supplemented by the unwritten law of the range, framed and enforced by those strong enough to take and hold possession for a brief term of years.

EFFECTS OF OVERGRAZING.

The result of such occupation is, usually, that excessive numbers of animals are put upon this free pasture, the profits are run up as quickly as possible while yet the range remains free, and then when the grass is gone, when the plains and hillsides are converted into gullied barrens, and oftentimes, when the profits of the first years are canceled by the losses of later ones, the nation's ruined estate is abandoned to the tender

mercies of the next and more ruthless occupant who may still find something convertible thereon.

The effect of this unregulated and destructive tenure varies greatly with those conditions of soil, topography, rainfall, heat, and frost which affect the endurance of a grazing country. More favored districts in more northerly, humid, or elevated situations still retain an important fraction of their primeval value; but in portions of the southwest where the soils are sandy and easily washed, where the rainfall is light and often untimely, where the hot, dry climate causes enormous evaporation, and where, consequently, the effects of unregulated grazing are most destructive, many great areas of formerly grassy country may be safely stated to be capable of supporting not one-tenth of the stock that once ranged there.

APPROXIMATE LOSSES.

It may be assumed, probably without exaggerating the loss, that the public grazing ranges of the West now average not more than half of their original value—lands, too, which can never be irrigated and for which there is no possible use but as grazing territory. Differently stated, this means that the United States, for want of proper laws to govern its public domain, has suffered a loss equal in effective value to, say, 200,000,000 acres of grazing lands, an area greater than the state of Texas or equal to a strip of territory 230 miles wide extending from the Rio Grande to the Canadian boundary. It is evident that only the wreckage of western grazing values remains to be legislated

for, and that the problems of the now depleted range are largely those of reconstruction for a failing country, occupied by more or less conflicting interests, by cattle, sheep, and goats, by large companies, and by small individuals.

There are few remaining to defend the old order of "free grass for all," for this regime, satisfactory enough when there was grass for all, has, with the failure of the ranges, demonstrated its own ruinousness.

THE NATURE OF THE PROBLEM.

The problem confronting range interests at this time is to devise land laws which shall enable a maximum population to support itself in a pastoral country, and to make these laws so flexible as to apply to all grades, both best and poorest, of grazing lands, harmonize all kinds of stock interests thereon, and provide for the often unexpected development, through irrigation, of agricultural lands within formerly purely grazing districts.

The existing conditions are those of a country reduced by overgrazing and bad management to a fraction of its possible value, and requiring to be fenced, reseeded, repaired, and protected in order to even partly restore that value.

UNSATISFACTORY REMEDIES PROPOSED.

Practically the only proposals thus far made to remedy existing conditions are to lease the public lands in blocks at stated rents, or to issue permits to individuals to run stated numbers of animals upon specified portions of the public range.

The unsatisfactory nature of these proposals is attested in part by their repeated rejection by one or another faction of those concerned, and for reasons quite evident when the merits of the measures are considered. Lease or fence laws permitting the control of large bodies of land on the basis of competitive bids are usually favored by the wealthier and better established stock-raisers, who would be at an advantage under such laws, and are earnestly opposed by the small men, who would be exterminated through their operation. Horizontal lease laws have been pro-

posed providing for the leasing of all grazing lands at the same rate per acre of rental. When it is considered that different grazing districts may easily require all the way from 3 to 60 acres to support a single cow, the unjust discrimination against the more desert ranges of a horizontal rate-per-acre lease law is too evident to require discussion.

The leasing idea, nevertheless, has a good foundation in the fact that it recognizes that in order to place the grazing industries on a stable basis, *stockmen, like farmers, must have control of the land upon which they operate*; but methods have not yet been proposed for an open and equitable division of grazing lands among applicants therefor.

The permit system, also, in one form or another, has many advocates—possibly largely for the reason that this method has been put into practice on forest and Indian reserves, and its results are known to those who would expect to take advantage of it. The permit system, however, is practically no better than free range with a tax added to the stockman's expenses and a more or less unsuccessful attempt on the part of the government to regulate the number of animals in a specified district. As under the free regime the stockman is not protected by assurance of permanent or long-continued tenure of his range, he consequently desires to get the whole value out of his concession while it lasts, and often yields to the temptation to place more animals upon his territory than his permit calls for. The destructive effects of the permit system as they are to be seen on certain Arizona reservations are not reassuring as to the good results of this method in practice.

AUSTRALIAN EXPERIENCE AND RESULTS.

It is doubtful, in brief, that a satisfactory method of disposal for western grazing ranges and their use as such has been devised, and we naturally turn at this time to Australia for suggestions. This country, which is and always has been more a pastoral than an agricultural region, for the last 75 years has been making and remodeling her laws

relating to the disposal of crown lands to settlers. The fruits of this long experience are of unusual significance to us at the present time. As they now stand, the land laws of various of the Australian states present the following sensible features: First. Grazing lands are divided, according to their capacity to carry stock, into as many as four classes, and settlers are permitted to occupy smaller or greater allotments of territory according to its quality. Second. These lands are occupied under long tenure leases, with renewal privileges, which give practically permanent control to the stockmen. In addition to the motive thus created to improve their leaseholds, they are also usually required by law to fence and otherwise improve their holdings. Third. The classification of lands and their allotment to settlers is done by boards of commissioners acting for the government, with a view to correct judgment and equitable division of public lands.

These are the leading features of those laws which have resulted from the better part of a century of Anglo-Saxon experience in a pastoral country.

The operation of these laws with reference to the development of pastoral industry is stated to be highly satisfactory. Vast areas of semi-desert lands, divided into comparatively small holdings, are legally occupied for long terms by stockmen who, prompted both by law and their own best interests, improve their holdings. Thus it is that in Australia an immense pastoral country has been fenced, substantial improvements are installed, provision is made against famine in dry years, animal pests are exterminated, poisonous plants are eradicated, and an era of improvement has apparently been inaugurated directly due to a recognition of the fact that the Anglo-Saxon must have proprietary interest in land if he is to be expected to improve its condition.

In unhappy contrast to the upbuilding of pastoral Australia is the reverse process everywhere evident in our own Western States. The spoliation which has resulted inevitably from the lack of laws having for their object a saving administration of the range country has resulted in a gradual but sure decline

of its carrying capacity. In some districts; especially where, under stress of overgrazing, the soil is easily eroded by rainfall, this damage can never be repaired; in others, restriction of grazing, reseeding, and other remedial measures may effect a large measure of restoration.

As to what these remedial measures shall be in the United States there is, of course, great difference of opinion, influenced in part by the interests of those concerned and in part by ignorance of the problem itself.

PRINCIPLES ON WHICH SOUND GRAZING LAND LAWS MUST REST.

Successful grazing range laws must of necessity rest upon two kinds of knowledge—knowledge of the range itself, the forages that it bears, their habits of growth and reproduction, their food value for animals, the classification of grazing country into different grades, and the carrying capacity and endurance of these different kinds of range. This is a subject the study of which within the past few years has been vigorously entered upon by various economic botanists, especially by certain of the state experiment stations and by the United States Department of Agriculture.

The second sort of knowledge required is that derived from legislative experience in dealing with purely grazing lands elsewhere. The results of such experience are to be found in Australia probably more than in any other modern country.

Australian experience, considered together with the traditions of our own land laws, points to the practicability in the United States of the stockman's homestead or long-term leasehold in pastoral districts. The homestead idea, long tried and well approved in this country, is, briefly, that a settler shall be granted enough territory to afford him a living—enough and no more.

THE MEANING OF THE HOMESTEAD.

As applied to the Mississippi Valley, a homestead meant 160 acres of land, this area being found in the average instance sufficient for a farming family; but when the tide of immigration pushed

west of the 100th meridian into the semi-arid regions, it was found either that 160 acres with water were worth a great deal more, or that 160 acres without water were worth vastly less than that same area back in the Mississippi Valley.

The far greater value of irrigated lands has been recognized and provided for under the terms of the Newlands act, and, according to the productive capacity of the lands developed by the Reclamation Service, the settler will be granted a greater or less portion adequate for his support.

Continuing the application of the idea, why should we not apportion grazing ranges on precisely the same principle, granting a sufficient acreage for a sufficient time to afford the small stockman the necessary territory to support the herd whose increase shall give him a living income and protecting him in his tenure for a sufficient length of time to create an incentive for the maintenance and improvement of his range?

In Australia, from 1,280 to 40,000 acres of grazing lands, according to quality, are thus leased, at rates proportionate to value, for terms of from fourteen to forty-two years. Many benefits are experienced under these provisions. Sheep and cattle wars are rendered impossible, since each interest is confined to its own territory. Coöperative arrangements are entered into extensively where coöperation permits of more economical management of large adjoining leaseholds. Grazing leaseholds are operated in connection with cultivated farms, and

humane methods of handling stock are rendered possible.

SOME SUGGESTIONS.

The operation of the grazing leasehold plan implies the creation of a suitable means for classifying grazing lands according to their productive capacity, and designating the various areas in different districts which will support, without destruction of the range, the income-producing herd of the small stockman.

Proper provision for residence upon and improvement of holdings should be made, insuring good faith of occupants and varying with conditions in different districts.

Coöperation should be recognized and provided for in districts where the sparseness of the range, the scarcity of water, and the comparative costliness of fencing makes it advisable for neighbors to act jointly.

Provision should be made for the renewal of a long-tenure lease by the original holder, provided the land remains purely grazing country; but in case of possible artesian or irrigation development provision should also be made for throwing the leasehold open to more intensive culture.

On these and other concurrent lines, as seems to have been demonstrated by the Anglo-Saxon sheep and cattle men of Australia, it should be possible to fulfill the purpose of our public domain and place upon it a maximum number of American citizens secure in their rights to sufficient territory to secure a living for themselves.

WOODS OF THE PHILIPPINES.

BY

EBER C. SMITH.

IN a previous article, referring to the forestry display by the Philippine Islands at the World's Fair, the narra wood was particularly described, it belonging to the superior group and first in general use for fine furniture, doors,

casing and flooring in the better-appointed dwellings.

A number of slabs, finely polished, in the Forestry Building and the handsome tables in it and various other buildings in the Philippine reservation are beauti-

ful specimens of narra. The piano in the Administration Building is also built of narra wood.

In my former article narra was called the mahogany of the Philippines, quoting Foreman, but on account of its close resemblance, texture, and specific gravity, it seems it would better be entitled to be called the "rosewood of the Philippines." It is eighth among the woods of the islands in resistance, twenty-third in elasticity, and thirty-first in specific gravity.

Of the fine woods of the superior group, calantas is the next in importance to narra. Of this wood there is an excellent display in the Forestry Building. The two large slabs, 39×5.1 feet and 4 inches thick, highly polished on one side, are magnificent samples of the calantas wood. From this and other specimens on exhibit the World's Fair visitor can form a good idea of its importance. It is fairly distributed over the islands and is worth from 5 to 6 cents per square foot on the beach where it is cut and 35 cents delivered in the log at Manila—\$100 per 1,000 feet linear measure in lumber in Manila. While these are the classified prices, they should not by any means be taken as a basis for business calculations.

With proper transportation, modern methods of chopping and handling logs, and good sawmills, taken together with the cheap labor that can be had in the islands, there is no reason why the fine woods of the Philippines might not be placed upon the markets of the world at a lower figure than similar woods from other countries.

Calantas grows principally on the islands of Luzón, Mindoro, Negros, and Paragua.

Of all the woods of the first order, calantas is first in elasticity, and is therefore most valuable for small boat building, for making cigar boxes, and ordinary constructions.

Of specific gravity it is forty-first, and for resistance there are 46 other woods rank above it. It is sometimes erroneously called cedar in America, on account of the close resemblance to the South and Central American cedar wood. It varies in shades from a blood red, black red, purplish red, to an ashy rose. It is not much subject to attacks of insects and is very durable.

The calantas is fragrant, and when burning emits an odor similar to that of juniper.

Molave, christened the "Queen of Woods" by the Filipinos, also belongs to the superior group, and grows wild in Cebú, Leyte, Luzón, Masbate, Mindanao, Mindoro, Negros, Panay, Paragua, Samar, Sorsogon, and many other islands. It is well displayed in the Forestry Building. It is worth upon the beach where it is cut 10 cents per square foot, 80 cents delivered at Manila, and \$145 per 1,000 feet of lumber. It is probably the most common and best known hardwood in the Philippine Islands.

The texture is fine and grainy and susceptible of a fine polish. It is of great value for building purposes on account of its great strength and being exempt from decay. It is cut into magnificent plank, and is used for flooring, door panels, and other furnishing and finishings in the construction of the better class of buildings. It is used in shipbuilding for everything excepting the keel. It is excellent wood for statues and other ornamental woodwork, as it is not subject to the attacks of insects, which deface and destroy many kinds of wood in the Philippines.

There are great opportunities for making money by handling the fine woods of these islands for the markets of the world.

A finer display of different kinds of woods has probably never been made than that contained in the Philippine Forestry Exhibit at the World's Fair.



PROPOSED IRRIGATION LAW.

DRAFT OF STATE IRRIGATION LAW TO BE SUBMITTED
TO LEGISLATURES OF WASHINGTON AND OREGON.

IN the September issue of FORESTRY AND IRRIGATION reference was made to the draft of a state irrigation law prepared by Mr. Morris Bien, of the United States Reclamation Service, at the request of irrigation commissions of the States of Oregon and Washington, appointed for the purpose of submitting draft of such a law at the next session of the legislatures of the two states. Copy of this pamphlet has now been received.

It is based upon the principles recently developed under the best irrigation practice, some of which are now incorporated in the laws of Idaho, Nebraska, Utah, and Wyoming.

The whole code is founded upon the principle of beneficial use as the essential feature of a claim to the use of water. It recognizes the waters of the state as the property of the public and subject to appropriation under a regular and orderly procedure as prescribed by the law. The rights which have already become vested, either by means of appropriation or by use under a claim of riparian right, are recognized as valid, and all claims to the use of water not applied to a beneficial use at the date of the act will be recognized as relating back to the date of initiation of the claim if the necessary surveys and construction for the application of the water to a beneficial use are diligently prosecuted to completion.

The draft provides for a state engineer, to be appointed by the governor and affirmed by the senate. He is to hold office for the term of six years, which makes his office as independent as possible of the political administrations, as he will hold over through one full administration. The draft provides that no person shall be appointed to this office except a technically qualified and experienced hydraulic engineer.

A large part of the cost of administration of this law will be paid by the

fees of the state engineer's office, which are turned into the general fund of the state treasury. These fees are very reasonable for each individual case, but the development of irrigation in these states will unquestionably afford in fees a very large part, if not all, of the cost of administration.

A number of sections are devoted to the determination of existing water rights. This is an important feature, as the present conditions in these states are very unsatisfactory, inasmuch as the claims to water are based on both appropriation and riparian rights, in some cases claims of both classes being asserted as to the same stream.

The state engineer is required to make a hydrographic study of each stream, obtaining the necessary data for the determination of all water rights. The results of such survey are then transmitted to the attorney general of the state, who is required within thirty days to enter suit for the determination of all rights in such stream system.

The appropriation of water is to be made under rules and regulations of the state engineer as limited by the provisions of law.

An important provision in this connection is that before a permit to appropriate water is issued by the state engineer the applicant is required to publish notice, containing all essential facts as to the proposed appropriation, in some newspaper of general circulation in the locality where the water is to be diverted or used.

After the completion of the work the state engineer is required to inspect it and then gives a certificate of construction, specifying the capacity of the works, and the right of appropriation is limited to such quantity.

It is required that the construction of the works shall be diligently prosecuted to completion, and if one-fifth of the work is not completed within one-half

the time allowed, it becomes possible for other applicants to obtain a right to the water which had been set aside for that work.

When the water has been applied to a beneficial use a license is issued by the state engineer, and the right to appropriate water then becomes fixed as to quantity and conditions.

Provisions are found in this draft for the recording of all water rights and documents relating thereto in the office of the state engineer.

A provision of considerable importance to the future development of these two states is found in section 36, which requires the state engineer to reserve from appropriation the waters which may be found necessary by the United States in developing the projects under the Reclamation Act. Other provisions place at the disposal of the Reclamation Service, at minimum cost, the lands of the state which may be needed for irrigation works and require coöperation with the government in the disposition of the state lands which may be subject to irrigation under works constructed by the Reclamation Service.

The state is to be divided into water divisions, probably four in number, and a water commissioner is to be elected in each division. These commissioners are vested with authority to regulate the apportionment of the waters in accordance with the adjudications of the courts and the permits issued by the state engineer. The water commissioners are specially required to guard against waste and to see that each appropriator of water receives the amount to which he is entitled. Water masters are provided for, to act under the supervision of the water commissioners in carrying out the details of their work.

The state engineer and the water commissioners form a board of water com-

missioners, who are vested with general supervisory authority over the various details of appropriation and distribution of water.

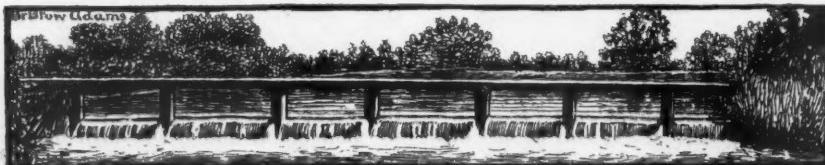
The expense of administration in regard to water apportionment by the water masters is borne by the ditch owners and the water users.

Under the head of miscellaneous provisions are sections defining the units of measurement. The cubic foot per second is adopted for measuring the flow of water and the acre-foot for measuring the volume. An important feature is a definition of the miner's inch as the equivalent of $\frac{1}{50}$ of a cubic foot per second except where otherwise determined by contract or usage.

A section is devoted to the provision for severing the use of water from land to which it is appurtenant for irrigation purposes. This can only be done upon the approval of the state engineer after due publication in newspapers of the intent to make such change.

Another section is devoted to the question of seepage water, which has been in many cases the subject of much difficulty and litigation. This provides that the party who proposes to use water which can be definitely traced as seepage from some particular canal or reservoir will be required to make reasonable payment to the owner of the irrigation works from which the water is derived.

There are many details in this draft—some of them being wholly new—that would be profitable to consider if space were available. The summary given, however, will enable the reader to see that the draft prepared for the consideration of the legislatures of Washington and Oregon will enable those states to place themselves in the foremost rank in the development of irrigation legislation if its principles are adhered to.



TO HARNESS THE MISSOURI.

PLANS LOOKING TO UTILIZATION
OF ITS WATERS FOR IRRIGATION.

BY

GUY ELLIOT MITCHELL.

TWENTY-FIVE years ago Major J. W. Powell, the greatest American irrigation authority, told the people of North Dakota, at their constitutional convention, some plain facts about this semi-arid section which they were then loth to believe, but which have since proven only too true. He told them that in the western portion of the state they would have to depend upon irrigation, and that in the eastern part they could grow good crops with natural rainfall, but that in the middle portion an entire dependence upon rainfall must ultimately bring disaster; that they would have a series of years when there would be abundant crops, and then for a number of years there would be scant rainfall, when crops would fail and disaster and discouragement would overtake thousands of people. Up and down the temperature of agriculture would rise and fall with the seasons—the lean years and the fat. "You will," he said, "hug to yourselves the delusion that the climate is changing. This question is 4,000 years old. Nothing that man can do will change the climate. There is almost enough rainfall, but one year and another you need a little more than you get. It is flowing past you in your rivers."

These words seem truly prophetic as the history of the Dakotas for the past 25 years is reviewed. The lean years came and the fat years, the years when there was plenty of rain and the soil produced abundantly, and the cycles of lean years came, when the farmers watched in vain for the fructifying rainfall and their crops burned to a brown and a crisp, and finally they abandoned their homes by hundreds and by thousands.

For three years in succession during that period, I was told, land which be-

fore and since yielded 20 bushels of wheat per acre produced but two poor bushels, while thousands of acres were never even harvested.

A WASTE OF WEALTH.

And the wealth of an empire is going by in the rivers, as Major Powell stated—flowing uselessly to the ocean. That is apparent enough to any one visiting the country. How to get the water onto the land is the question. For the very reason that dry farming may succeed but little interest has been taken in irrigation. But the farmers of North Dakota are awakening. They are realizing that it is a false pride which proclaims that irrigation is not needed, for with irrigation they will have a safe and sure crop and one vastly more productive. The business men, too, are beginning to see that small farms, intensively cultivated and made to produce the maximum yield, contribute much more to the growth and upbuilding of the state than do large ranches, half farmed, or wild hay land.

THE FORCEFUL MISSOURI.

A certain Western Senator, in a cloak-room conversation on irrigation last winter, stated it as his belief that the Missouri could be dammed at various points and all its flood waters saved for irrigation. This statesman was from the far, far West, where all things are easily possible. The Missouri is a vast yellow giant. It flows through North Dakota, even in low water time, a titanic mill-race, in which a strong swimmer may perhaps trust himself, and be swept down stream as fast as a man can run. In flood, when the Rocky Mountain snows are melting, it is the embodiment of power, if not destruction, tossing its tawny mane as it sweeps before it mil-

lions of tons of earth, cutting out new channels and building up new lands miles and miles in extent. Some day it may be possible to put in a great dam a couple of miles wide at one or two points where the river is confined between high sandstone bluffs; but this would be a work which, while it would create a great empire of its own, would make the Nile dam, with its 25 millions of cost, sink into comparative insignificance.

WHAT CAN BE DONE TODAY.

But there are other means of making the Missouri contribute to American prosperity. The writer was fortunate enough to take a trip of some hundred miles up the river on a steamer piloted by the last of the old-time river kings, Captain Grant Marsh, famous as a pilot and river explorer under Custer, Forsythe, Sheridan, Miles, and an important factor in many Indian expeditions. There was little in common in my uneventful trip and such a one as when Captain Marsh brought back to Bismarck the first news of the dreadful Custer massacre, which made 26 widows of army officers stationed at Fort Lincoln, just across the river, and brought likewise a score of wounded soldiers from Reno's detached troops. The Sioux have had their passing and ranchers and farmers may dwell and till without fear of swift annihilation from marauding braves. But from the pilot-house of the little steamer I could discern, in the not far future, a development along the Missouri which would work a yet greater change than that of the past decade. For hundreds of miles the river is encompassed by steep bluffs from 200 to 250 feet high and from 2 to 3 miles apart. Between these the river winds, a stream of from a quarter to a half mile wide, gradually changing its course from side to side, but forming great areas of "bench" lands 20, 30, and 50 feet high—hundreds of thousands of acres of surpassingly fertile soil, needing only irrigation. And the watering of this land turns out to be among the easiest of projects.

Every bluff of the Missouri showed a coal vein of from 6 inches to 12 feet in

thickness; in fact, enormous areas of North Dakota are underlain with splendid lignite coal, worth at the mine only a dollar a ton. There you have it. The water of the Missouri, a limitless, ceaseless supply, just above it land made by centuries of river sediment, and immediately at hand one of the cheapest known fuels to pump the water onto the land. It did not take an engineer to see the feasibility and cheapness of this undertaking.

But why, I asked myself, had it not been done? Why had not farmers themselves put in windmills and small pumps? Was there, after all, some insurmountable obstacle? No. Talks with a few of them showed them as ignorant of irrigation and its simplicity as are the farmers of Vermont. In fact, they were "rainfall" farmers and they spoke of irrigation as a mysterious and complicated process.

UNCLE SAM TO PUMP THE MISSOURI.

My return to Bismarck justified my conclusions. I found two government engineers even then investigating the problem, and, far beyond supplying the great areas of lower benches, they propose to elevate the water a hundred and possibly 200 feet out onto the great mesas. I left them preparing for a trip down the Missouri from the Dakota-Montana line, in a small skiff, on a careful reconnaissance of the Old Muddy, its tributaries and its lands. If they find conditions as favorable as they would seem, a party of surveyors will be put upon the project at once to make surveys and detailed plans, to be followed by the installation of giant pumps, water engines, each of which will create a small river.

This work of the government is fraught with unbounded possibilities for North Dakota. A great empire lies latent in the midst of the state, the worth of which her own people are but beginning to comprehend. The fertility of the ages is stored in the ink-black soil and the water of half a continent flows by, an unused agent of wealth.

The day of great things for the land of Laughing Water may be close at hand.

RECENT PUBLICATIONS.

Elementary Wood Working. By EDWIN W. FOSTER. Pp. 133. Illustrated. Ginn & Co., Boston.

This little volume has for its purpose the furnishing to high-school and other students the essential facts about tools and their uses. It not only describes, but illustrates, the various tools used in wood working; and there are chapters on lumbering and milling. The principal timber trees are also described. Altogether the volume contains much information of a practical nature that should be useful to the average person.

Our Mountain Garden. By Mrs. THEODORE THOMAS. Pp. 212. Illustrated. Macmillan Company, New York. \$1.50 net.

Mrs. Thomas' experience in producing her mountain garden, which included the building of a summer home, will delight and be profitable to both those who are amateur gardeners or who contemplate becoming such. The desire to build a home and beautify its surroundings has ever been strong in the average breast, and never more so than in recent years. The desire to "personally conduct" the operations seems to be the rage, and a right healthy sign it is. The whole work in connection with Mrs. Thomas' house and garden was superintended by and much of the labor done by herself. It is for this reason that her narrative is so interesting and full of practical hints. The book is delightfully written also and in many ways it suggests Arthur Henry's admirable volume, "The House in the Woods," with which it does not suffer in comparison.

Getting Acquainted with the Trees. By J. HORACE MCFARLAND. Pp. 241. Over 100 illustrations. Macmillan Company, New York.

This volume contains eight chapters in popular vein on some of our best-known trees. Mr. McFarland's connection with the book as author, illustrator, and printer is sufficient guarantee as to its artistic side. It is undoubtedly one of the handsomest nature books we have seen, and as a guide to certain classes of our trees will be of much value to amateur dendrologists. The illustrations, numbering more than one hundred half-tones from photographs, are striking examples of the engraver's and printer's skill.

Weather Folk-Lore and Local Weather Signs. Bulletin No. 33, U. S. Weather Bureau. By Professor EDWARD GARRIOTT. Pp. 174. Illustrated with maps. Government Printing Office. Price, 35 cents.

This is an interesting as well as a valuable publication, the first part classifying all the "sayings" and legends of the weather in so far as they hold true, and the second containing summaries of local weather signs at Weather Bureau stations throughout the United States as indicated by the reports of the Bureau's observers. The mass of weather folk-lore has been threshed out until only those legends or sayings which have been found true in practi-

cal application, in whole or in part, remain. These are further classified with explanations and notes, under the heads of Wind, Clouds, Barometer, Temperature, Humidity, Animals, Birds, Fish, Insects, Plants, Sun, Moon, Stars, Sun-spots, Days, Months, and Years, etc. Sayings, legends, tales, and folk-lore concerning the weather that have been handed down from generation to generation by French, German, Swiss, Scottish, and other foreign peoples, together with the writings, prose and poetic, of their languages, and the ancient couplets, quaint legends, and curious rules from our own ancestors are given, with explanations of their meaning and how nearly true they prophesy. The second part of the book is intended particularly for the amateur meteorologist, and contains the material submitted by the Bureau's observers throughout the country on which predictions are based.

Floods of the Spring of 1903 in the Mississippi Watershed. Bulletin M, U. S. Weather Bureau. By H. C. FRANKENFIELD. Pp. 63. 15 charts and numerous half-tone illustrations. Government Printing Office. Price, \$1.00.

The floods of 1903 in the Mississippi Valley resulted in immense general damage to property in that vicinity, and this publication is a discussion of their causes and effects, arranged by localities, with a general description of their courses, and with special reports bearing on the subject. The illustrations, two of which are reproduced in this number of FORESTRY AND IRRIGATION, portray graphically the tremendous damage wrought. It is an exhaustive summary and history of the entire flood, and a number of charts showing precipitation during periods preceding and during the flood, with other data, are appended. The report is particularly valuable in that it contains the official figures and tabulations of the rise and fall of the flood and the losses and technical reports of the Weather Bureau's trained staff.

Proceedings of the Iowa Park and Forestry Association. Third Annual Meeting. Pp. 173. Illustrated. Published by the Association. 1904.

About twenty-five valuable papers, delivered at the Third Annual Meeting of the Iowa Park and Forestry Association, held on December 7 and 8 of last year, are preserved in this volume. The Association is doing much to encourage the practice of forestry in Iowa and education in its principles, with the creation of national parks and preservation of game, and the papers of this meeting are for the most part on these subjects or their special phases and applicability to certain conditions. The contents are divided into the business of the meeting proper, with minutes, and the papers read, classified under Forestry, Parks and Grounds, Schools and the Trees, and The Ästhetic Side of Forestry. Numerous illustrations amplify upon the text, and the whole makes one of the handsomest volumes of its kind that has been received.

Foresters and Inspectors Wanted for the Philippine Forestry Bureau

The salaries of Foresters, Assistant Foresters, Inspectors, and Assistant Inspectors range from \$1,200 to \$2,400 per year. Actual and necessary traveling expenses to and from the scene of field work are allowed, and while in the field one dollar gold per day is allowed for subsistence.

There are a number of vacancies in the different grades, and good men are urgently needed for this interesting and important work.

The work of the Foresters is, to a large extent, technical; that of the Inspectors more administrative and less technical.

Examinations will be held in different parts of the United States about July 1 and November 1. For detailed information apply to the Bureau of Forestry, Washington, D. C., or to the Bureau of Insular Affairs, War Department, Washington, D. C.

Foresters and Inspectors now in the Philippine forest service and having from two to three and a half years' service, find the work very attractive, instructive, and healthful.

Copies of the Philippine Civil Service Manual may be obtained from the Bureau of Insular Affairs, War Department, Washington, D. C.

The reports, bulletins, and other publications of the Philippine Forestry Bureau should be read by all desiring to enter the service. Copies may be obtained by addressing the Forestry Bureau, Manila, P. I.



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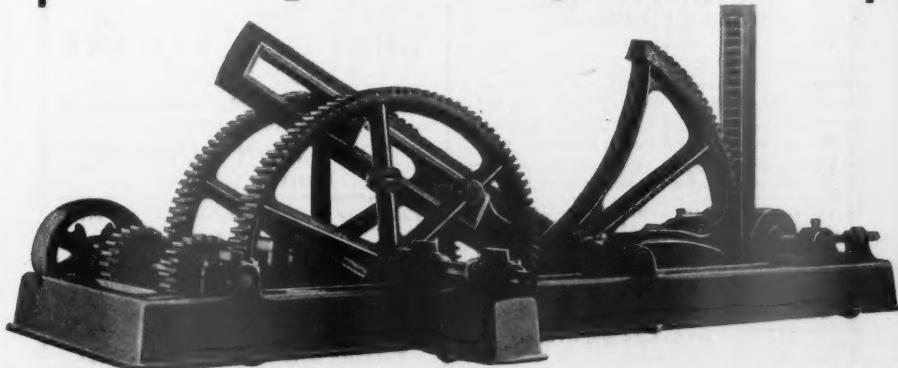
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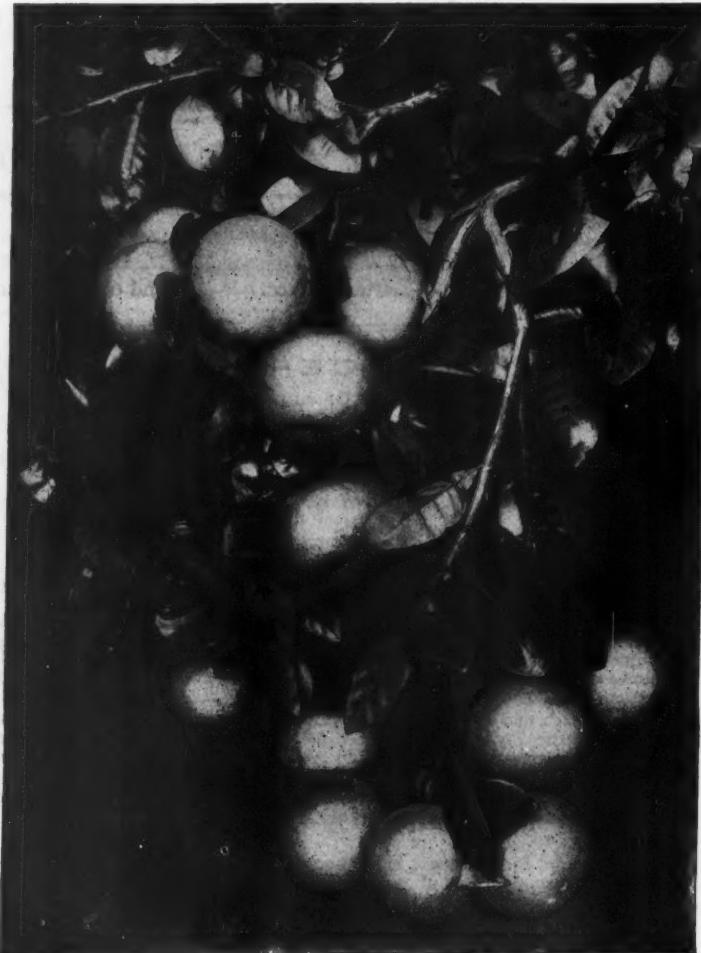
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2. The preservation and development of our national resources by the construction of storage reservoirs by the Federal Government for flood protection, and to save for use in aid of navigation and irrigation the flood waters which now run to waste and cause overflow and destruction.
3. The construction by the Federal Government of storage reservoirs and irrigation works wherever necessary to furnish water for the reclamation and settlement of the arid public lands.
4. The preservation of the forests and reforestation of denuded forest areas as sources of water supply, the conservation of existing supplies by approved methods of irrigation and distribution, and the increase of the water resources of the arid region by the investigation and development of underground supplies.
5. The adoption of a harmonious system of irrigation laws in all the arid and semi-arid states and territories under which the right to the use of water for irrigation shall vest in the user and become appurtenant to the land irrigated, and beneficial use be the basis and the measure and limit of the right.
6. The holding of an annual Irrigation Congress, and the dissemination by public meetings and through the press of information regarding irrigation, and the reclamation and settlement of the arid public domain, and the possibilities of better agriculture through irrigation and intensive farming, and the need for agricultural education and training, and the creation of rural homes as national safeguards, and the encouragement of rural settlement as a remedy for the social and political evils threatened by the congestion of population in large cities.

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